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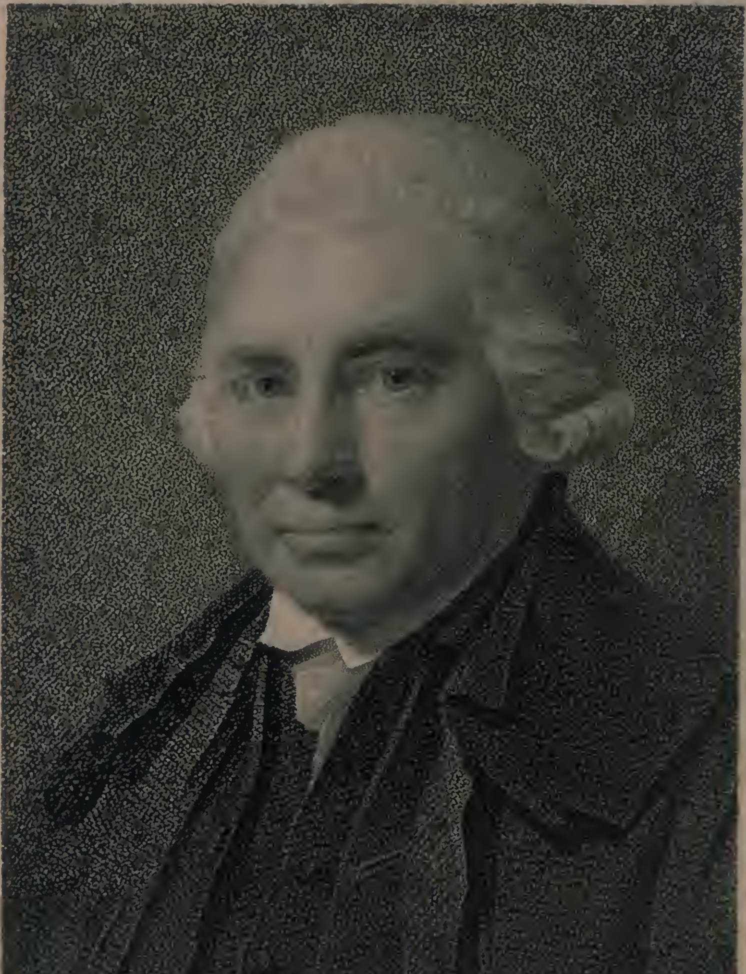
ESSAYS

AND

HEADS OF LECTURES

ON

ANATOMY, PHYSIOLOGY, PATHOLOGY, AND SURGERY.



Alexr. Monro M.D.

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ESSAYS

AND

HEADS OF LECTURES

ON

ANATOMY, PHYSIOLOGY, PATHOLOGY, AND SURGERY.

SOLD BY H. M. STATIONERY OFFI

BY THE LATE

ALEXANDER MONRO SECUNDUS, M.D.

F.R.S.E., &C.

UPWARDS OF FIFTY YEARS PROFESSOR OF ANATOMY AND SURGERY IN THE
UNIVERSITY OF EDINBURGH.

WITH A

MEMOIR OF HIS LIFE,

AND COPIOUS NOTES EXPLANATORY OF
MODERN ANATOMY, PHYSIOLOGY, PATHOLOGY,
AND PRACTICE,

BY HIS SON AND SUCCESSOR.

[Alexander Monro, Tertius. M.D.]

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TO

ARCHIBALD ROBERTSON, M.D.
F.R.S.L. & E.,
PHYSICIAN TO THE GENERAL INFIRMARY, NORTHAMPTON:

THE FOLLOWING PAGES ARE INSCRIBED

IN TESTIMONY

OF THE

MOST SINCERE ESTEEM AND FRIENDSHIP

OF THE EDITOR,

ALEXANDER MONRO.

PREFACE.

Sir Astley Cooper, the late Professor J. Gregory, Dr Carmichael Smyth, and Dr Robertson, having made honourable mention of my Father's Lectures,* of which the subjoined Essays formed a part, I have been induced to publish the following Volume, in the hope that it may prove acceptable to the public, and more especially to his surviving pupils. Various notes have been added, to enable me to supply some of those deficiencies which the progress of time has pointed out, and to rectify opinions which experience has proved to be fallacious. Considerable difficulty has been experienced in this part of the work, arising chiefly from the prescribed limits of this volume; and in reviewing my Father's Book on Fishes, no notes have been added, as these alone would have filled a large volume.

---

* *Vide* Memoir, pages 6, 9, 13, and 29, &c.

In preparing the other parts of the manuscript for the printer, I have been led to add note after note, so that these have become more extensive than was at first intended. This has compelled me to abridge the number of Essays, and to substitute extracts from my Father's Lectures on those subjects on which his researches have thrown considerable light.

A more full prefatory Memoir of the Life and Writings of Dr Monro Secundus has been given than has been hitherto published; and in reviewing his several works, very short notices have been given of some of the more modern discoveries on the subjects of Anatomy, Physiology, Pathology, and Surgery, on which he has written.

A few engravings have been added for the sake of illustration.

Before concluding, I take leave to offer my most grateful acknowledgments to those friends whose communications have added so much to the interest of the following pages.

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ERRATA.

At p. xvii, for *Ceely*, read *Mr Ceely*.
p. xxviii, for ἡπειρα, read ἡ πειρα.
p. xxxii, for *et diable*, read *le diable*.

MEMOIR

OF THE

LIFE AND WRITINGS

OF

DR ALEXANDER MONRO SECUNDUS.

Biography, being a very attractive department of history, has been popular in all ages. The allurements of biography are no less varied than numerous: it affords amusement and instruction, whilst it gratifies curiosity, by describing the lights and shadows of character,—proves a beacon against vice and folly, which have often obscured the lustre of great talents. To some it recalls the memory of deceased friends and past events,—it pays a just tribute to departed worth,—shews whether or not an author has practised those principles he has advocated,—and also points out the only road to excellence, which, as Sir Joshua Reynolds has well observed, "is granted to man but as the reward of labour."

The efforts of the pen, like those of the pencil, are too often abortive, and do not present a just picture of the character of the individual. Pictures are often but maps of the features, but do not indicate the workings of the mind; and give no idea of many of the slighter shades of character, which, taken singly, produce little or no effect, but, in combination, constitute a striking likeness.

It may be supposed by some, that a son is disqualified from writing the life of his father. The observation is, no doubt, so far correct: but still if that son (as in the present case) has had most able assistance in correcting and finishing his history, and if he steadily keeps in view the remark of the Younger PLINY to TACITUS, "Nam nec historia debet egredi veritatem, et honeste factis veritas sufficit," (PLIN. Ep. 7.—33.) a great part of the force of such an objection is obviated. Besides, it must be admitted, that a son is more conversant with the habits, opinions, associates, and writings of his father than other persons. It may be added, that the author has been urged to this undertaking not by self-conceit, but by a wish to fulfil the intention his Father had of publishing the Essays contained in this volume. Moreover, he feels that he is complying with the voice of the public, and at the same time discharging a debt of gratitude to those friends who have lent their aid.

To render the following pages more interesting and instructive to the younger part of the profession, the author has added notes, comparing the opinions of his father with those of the present day; and if rather narrow limits had not been prescribed to this memoir, even a more extended range would have been taken; a detailed account would have been given of preceding authors, so as to connect the discoveries of former ages with those of our own.

To dwell on the boyhood of Dr MONRO secundus seems superfluous: it may suffice to state that he was the youngest son of Dr ALEXANDER MONRO, father of the Edinburgh Medical School, by ISABELLA MACDONALD, second daughter of Sir DONALD MACDONALD, Bart., and was born May 20. 1733. Having given, at an early period of life, proofs of acuteness of mind, he was placed under the tuition of Mr MUNDELL, from whom he imbibed his intimate knowledge of the Latin and Greek languages. He was entered at the University of Edinburgh, and passed through the usual course of study prescribed for those who are destined for the learned professions. He was a great favourite with Professor MATHEW STEWART, who devoted to him a great deal of attention. This he afterwards frequently acknowledged with gratitude, imputing to the instruction of this very learned Professor the reputation he afterwards acquired as a close and argumentative lecturer.

He evinced, at an early period of life, a predilection for anatomy. It was this department of science in which he was most anxious to excel, to which the whole force of his genius was directed; and at a very early age he gave presages of his future attainments, which were fostered with great care by his father, and also by the other very able professors of the University. His father had designed him for the medical profession, and also indulged the hope of deriving assistance from him in teaching anatomy. Dr Monro secundus was peculiarly fitted for this latter duty. He possessed an insatiable thirst for medical knowledge, an uncommon share of perseverance, and a very good memory (for the cultivation of which he had been very much indebted to the excellent discipline of his mother), seldom forgetting any circumstance of moment which he had observed in nature, heard in conversation, or gleaned from books.

During the second season of his medical studies, his father, in consequence of his audience having increased so rapidly that his room could not contain them, had been driven to the resolution of repeating his lecture in the evening. This proving to him a very irksome task, and being conscious of the competency of his son to give every satisfaction, he imposed the duty of delivering the evening lecture upon him. The pupils became speedily convinced of the propriety of this choice. His fame as a teacher having thus reached the public ear, he was, when only twenty years of age, appointed Assistant-Professor of Anatomy and Surgery, on 12th July 1755.

He entered the University at a most favourable time when the sciences of Anatomy, Medicine, Surgery, and Chemistry, had made great progress, and when the Chairs of the University were filled by distinguished Professors.

Dr Monro secundus took an active share in his own department. " He examined," as Dr Samuel Johnson most justly observes of Boerhaave, " systems by experiments, and formed experiments into systems. He neither neglected the observations of others, nor blindly submitted to celebrated names. He neither thought so highly of himself as to imagine he could receive no light from books, nor so meanly as to believe he could discover nothing but what was to be learned from them. He examined the observations of other men, but trusted only to his own."

Dr Monro secundus, during the prosecution of his medical studies, published observations on gravid uteri (vide Physical and Literary Essays, vol. i. art. 18.); and in the same book, a description of the seminal vessels, (vide art. 16), which he afterwards extended, and published as his Thesis, and in it he gave a much more complete account of the structure of the testicle than had been published. In his Thesis, he adduced many arguments to prove that lymphatic vessels exist in every part of the body, and are absorbent vessels.

While a student, he also made many experiments on the effects of stopping the flow of blood through the larger arteries,—on the formation of bone,—and as to the causes of danger which attend the operation of the trepan, which proved that the mere division of the skull is fraught with no danger, but that, when the dura mater is injured, the operation is often attended with extraordinary danger, and indeed often followed by death. These experiments also pointed out the advantage of dividing the integuments of the head, before trepanning, in a crucial direction, or like the letter T, so as to save as much skin as possible, rather than to remove a circular piece, or to scalp the patient, as it was then called; thus the cure is very much accelerated.

After having obtained the degree of Doctor in Medicine, in 1755, he resolved to visit the Continent, in order to prepare himself for the discharge of the several arduous and important duties of the Anatomical and Chirurgical Chair.

He went first to London, where he attended the lectures of Dr William Hunter; but he remained only a short time in the metropolis, and rather with a view of forming an acquaintance with the most distinguished men of that day, than of prosecuting his anatomical studies. After visiting London, he crossed over to Holland, visited Leyden, where he formed an intimate acquaintance with the justly celebrated Dr Albinus.

Whilst on the Continent, he was so fortunate as to form an acquaintance with Dr P. Camper, that ripened into an intimate friendship, which continued during their lives, and with whom he kept up a frequent correspondence.

He spent a considerable time at Berlin, and whilst the inmate of Dr Meckel, made many beautiful preparations of the lacteal and lymphatic vessels, which he shewed to Dr Meckel, and his assistant Walther, and others.

Dr Monro, whilst at Berlin in 1757, was led, by a case he had seen, to propose the puncturing the thorax, to give vent to air effused into it. On this subject, I add an extract of a letter Dr Monro wrote to Mr Hewson, dated Edinburgh, June 8. 1769, and afterwards published:—

"The winter before last, in March 1768, when I came to treat of the paracentesis of the thorax, I explained the several disorders on account of which this operation ought to be performed, and symptoms by which these might be distinguished from each other; and then shewed the method of operating, in the very way I had done in all my former courses.

"I advised that an incision should be made, through all the containing parts, for the discharge of water, pus, or blood; as, indeed, is recommended by the most eminent writers in different nations, Sharp, Le Dran, and Heister; and mentioned that I had made the operation be done, in that way, on two persons.—But, for air effused, the several causes and effects of which effusion I had before explained, I advised that the common teguments should be cut with a lancet, and that a perforation should then be made into the cavity of the thorax with a small trocar, passed obliquely and worked very cautiously like a drill; and gave several reasons for preferring that method to an incision; and I have since caused it to be practised on one patient with the utmost advantage."

Dr Monro was compelled, on account of the declining health of his father, to return home sooner than he expected, and to assume the duties of his office as professor. Of the estimation in which he was held as a lecturer it is not for me to speak. I therefore subjoin the following Letter which I received from my friend Dr Robertson, upon his being informed that a Life of my Father was about to be published.

DR ROBERTSON'S LETTER.

"My Dear Sir, Northampton, *May* 21. 1839.

"I am delighted to hear that a Life of your celebrated father is about to be given to the world. His was a "magnum et venerabile nomen;" and a Biography of him, I venture to predict, will be received with the greatest avidity and gratitude by the profession. Indeed, I cannot but wonder that the Life of so great a man has not issued from the press long ere now. His achievements in the field of anatomical discovery, his eminence as a public teacher, his reputation as a practical physician, his sagacity as a pathologist, to say nothing of the long series of years during which he filled, with high credit, the important Chair of Anatomy and Surgery in the University of Edinburgh, might well have earned for him such a mark of distinction. Your father was in the foremost rank of that illustrious band of professors who adorned the medical school of Edinburgh at a time when that school was rich beyond any former example in great men. His celebrity may be said to have been commensurate with the globe itself! Well might he have exclaimed,

> "Quæ regio in terris nostri non plena laboris?"

For where was there a corner of the civilized world to which his pupils had not penetrated, or to which his fame had not reached? The biography of Dr Monro will recall to his pupils the remembrance of that copious stream of information—medical, surgical, physiological, and pathological,—that flowed from him almost without art or effort, fertilizing, from year to year, the successive crops of students that sprang up around him, all eager to imbibe the wholesome waters of a fountain so classically pure, and so prodigally abundant."

"By all who heard him, the value of his lectures will be long remembered. His eloquence was of an unusual sort; while apparently it aimed at no display, it told most effectively; lucid, impressive, and earnest, it had what might be called paternal simplicity and gravity, which chained the attention of his youthful audience, and removed his addresses, both as to manner and matter, to an immeasurable distance from the more beaten track of common Academic instruction.

"Though his usual style of elocution was grave, dignified, and remarkable for its calmness, there were occasional striking exceptions, viz. when topics of controversy or peculiar interest came under discussion. One of the most memorable of these was, when he combated the doctrine of Scarpa as to the pathological nature of aneurism.

"That eminent Italian professor had then just published a work, in which he altogether denied the existence of true aneurism, arising from a simultaneous dilatation of the three coats of an artery, holding the opinion that there was a rupture of the inner and muscular coats, and a dilatation only of the external covering of the vessel. Dr Monro criticised this opinion with exceeding freedom, and controverted it with all his might. After vigorously debating the matter, he produced a most illustrative preparation of true aneurism, in which a section of the tumour exhibited an uniform dilatation of the three coats of the artery, and carried it round the class in triumph.

"It was curious to observe the excitement that lit up his habitually benign countenance, as he held up for inspection this unanswerable preparation, and thus gave a coup de grace to the doctrine of SCARPA."

There is another circumstance meriting notice; he never used notes, and, indeed, possessed, for many years, heads only of his lectures. In consequence of the great extent of his memory, and his intimate acquaintance with the varied subjects of which he treated, and probably, also, from the very rapid advancement he made, at the very outset of his career, as a physician and consulting-surgeon, he never had had leisure to write out fully any one lecture. During fifteen years he lectured from heads of his lectures, the arrangement of which he repeatedly altered, perspicuity being his first and great object of attainment. He was at length relieved from this embarrassment, by purchasing from Mr JOHN THORBURN, who became his pupil in 1775, a copy of his own lectures. Mr THORBURN also took full notes of the lectures of Drs CULLEN, GREGORY, and BLACK, and sold these at the high price of 5 guineas a copy, a testimony highly creditable to the Professors as well as to the diligence and accuracy of the transcriber; and through this medium, the opinions of the different Professors were promulgated far and near in separate dissertations, or engrossed in general collections, but they are too often obscured by the common-place matter in which they are involved.

Messrs M^cFARQUHAR and BELL, publishers of the original *Encyclopædia Britannica*,—one of the most popular books that has issued from the British press,—acknowledged their obligations to my father's lectures, and, at the same time, presented him with a copy of the book, which extended to three large quarto volumes.

I am fortunately enabled, through the kind offices of four very distinguished persons, to produce testimonies, more impartial than my own could possibly be, and therefore entitled to greater weight, as to the value of my father's lectures, and the character he bore as a physician and consulting surgeon. The reader, I am persuaded, will peruse with pleasure the annexed documents from the pens of Drs James Gregory, Carmichael Smyth, Robertson and Sir Astley Cooper,* who had been his pupils at different times, and who continued till his death to be his intimate and valued friends.

DR GREGORY'S LETTER.

"The late Dr Monro of Edinburgh, long and most deservedly enjoyed the highest eminence which any man of the medical profession ever attained in Scotland. As an able, active, and meritorious professor of anatomy and surgery, he was, for more than half a century, at the head of the great medical school of Edinburgh, and for the greater part of that time, as a practical physician, he was unquestionably at the head of his profession in Edinburgh, and in Scotland; to many, even very distant parts of which he was often called, and from every part of which, as well as of England and Ireland, he was frequently consulted by letter, in cases of peculiar difficulty or danger.

"Hardly any life, even of a literary man, can be conceived to afford fewer interesting materials for a biographer than Dr Monro's. It was distinguished by no striking event,—it was checquered by no vicissitudes of good and evil; it was a life, from early youth to extreme old age, of almost uniform and uninterrupted prosperity. Nay, he seems scarce to have felt any of those difficulties and discouragements in his splendid career, which most men of literary professions, but especially physicians, experience in their laborious progress to the highest honours and rewards to which they can aspire; and certainly his progress never was retarded by any such adverse circumstances. His success, on all occasions, like the victories of Timoleon, seemed always to be accomplished with ease; yet it cannot, on this account, be attributed altogether to good fortune, or mere chance. Some favourable, almost accidental, circumstances contributed, no doubt, to his great success in life; but much more of it must be attributed to his own merits, to his constant unexampled activity in every pursuit in which he engaged, and to his good sense in perceiving and improving those advantages which might be considered as mere favours of fortune.

---

* Sir A. Cooper dedicated Part II. of his admirable book on Herniæ to Dr Monro secundus.

"It must be useful and instructive, and, therefore, in some respects interesting, to know what fortunate circumstances, and what merits of his own, chiefly raised him to that eminence which he so long maintained.

"By his father, he was from his earliest youth carefully instructed in anatomy, and soon acquired such a taste for that science, and prosecuted the study of it with such ardour and perseverance, that, in the year 1753, he assisted his father in his anatomical lectures in the University; and, in the year 1755, was appointed conjunct Professor of Anatomy and Surgery along with his father, who resigned the office entirely to him in 1758. From that time, he continued to teach regularly for more than fifty years. His lectures were attended by vast numbers of students, generally from 200 to 400 every year. But in the whole time, fifty years or more, that he taught anatomy and surgery, his lectures were attended, in all by fourteen thousand students.

"This, of itself, may well be regarded as a good proof of the merit and usefulness of his lectures, which indeed were conducted on a plan of the most extensive utility. It may well be doubted whether so useful a preliminary and preparation for the study and practice of physic and surgery ever had been given before in the form of lectures, or in any other form.

"Dr Monro's acknowledged merit as an anatomist, and as a teacher of surgery, though he was not himself a practical surgeon or operator, almost immediately brought him into very extensive practice as a consulting physician, in the more important and difficult chirurgical cases; and in many cases, strictly speaking not chirurgical, as not requiring or admitting of relief by any kind of manual operation, but for the complete understanding of which, with a view either to prognosis or to practice, the most accurate anatomical knowledge is peculiarly requisite.

"The quickness and clearness of his perception in such matters, his strong good sense, his decisive judgment, and the intimate knowledge of every part of the practice of physic, which he uniformly displayed on those occasions, soon, and most deservedly, procured him general confidence, and very extensive practice as a physician.

"Perhaps no man of the medical profession ever more strongly illustrated by his conduct, and by the general tenor of his practice, the important truth, that the most valuable part of a physician's merit is good common sense steadily employed on a particular subject. If that one essential requisite be wanting, learning, science, genius and every other accomplishment, are of no avail.

"It is recorded of an ancient Greek physician, whose name (TROPHILUS) and whose apophthegm, but none of whose writings, have descended to us, that when he was asked, 'Who would be a perfect physician?' he answered, 'He who is able to distinguish what can be done, and what cannot be done.' As this apophthegm has been preserved, it is plain that his countrymen and cotemporaries perceived the truth, acknowledged the merit, and felt the force of it; as every physician must do at once who has been much engaged in practice, and who has fairly attended to what he saw.

"But most physicians seem either never to have known, or obstinately to have disregarded, that most important and almost self-evident truth; and very few of them have had the merit of regulating their practice according to that most precious maxim.

"This merit Dr MONRO possessed in a very high degree. His just notions of general science, his thorough knowledge of medical science, but especially of anatomy, and of that part of pathology, with respect to the nature, and causes, and seats of disease, which is ascertained by the dissection of morbid bodies; or what is often called morbid anatomy; and most chiefly his own strong good sense, and constant habit of strict attention and accurate observation, in his own practice, enabled him to perceive at once, the futility of many hypothetical and erroneous, but very fashionable and prevailing doctrines with respect to the nature and causes of many diseases; and of course led him to distrust, and often to reject, as unavailing at least, if not even hurtful, many supposed remedies, and modes of practice, which were generally employed in consequence of those hypothetical dogmas.

"The same accomplishments equally prompted him, and enabled him, to appreciate the real merits of many remedies which, from time to time, were introduced into practice with the most extravagant applause, purely on empirical principles: that is on experience, real or supposed, of their good effects, without even an attempt to account for those supposed effects, or any pretence to explain their mode of operation.

"Thus most effectually preserved from two of the worst and most frequent causes of bad medical practice, *his* had the merit of being simple, rational, and powerful, perhaps as powerful, and consequently as successful, as can be employed in the present imperfect state of medical science. But even the being spared the misery of enduring the administration of many unavailing remedies, bad if only frivolous, but much worse if severe also, was a matter of infinite consequence to his patients.

"Of his merit as a practical physician, when acting singly, his professional brethren, who have had occasion to consult with him, cannot fail to have a very high and just notion, when they recollect what his conduct was in consultation. Without any subtile disquisitions, without any controversies about obscure or disputed points, without any credulity as to the virtues of particular remedies, and far above the miserable vanity of arrogating to himself any superior skill, or pretending to extraordinary success in his own practice, he was generally the first to propose, and always was ready most candidly to agree with others who proposed, those simple and powerful modes of practice, from which alone, in urgent and dangerous cases, any essential benefit can be obtained. And in the many hopeless cases, in which his assistance was required, he was generally the first to observe that 'little or nothing can be done in this case;' or 'there is no room for active practice here.'

"Such remarks invariably led to the very humble and modest, but only rational practice which can be employed in these cases, the administration of remedies which may alleviate the sufferings of the patient, though they cannot cure the disease."

By a remarkable coincidence I am enabled to submit to the reader, an account, by most competent judges, of the very first course of lectures which my father delivered in the year 1758, in conjunction with his father, and also of the last course of his lectures in which he took a part, in the session 1806–7, when I acted as his assistant. For the former I am indebted to the late celebrated Dr CARMICHAEL SMYTH, and for the latter, to a no less distinguished physician, Dr ROBERTSON of Northampton.

LETTER FROM DR CARMICHAEL SMYTH.

"DEAR SIR, CHARLTON, *November* 19. 1817.

"I SHOULD be highly gratified could I imagine, that any observations of mine on the late Dr MONRO's career as a professor of Anatomy, could contribute in the smallest degree to illustrate his character. But when I attended his lectures, I was too young and too little acquainted with the subject, to judge or appreciate his merit. As it is, however, possible that, after a period of nearly sixty years, I may be the only one now alive who was present at his de-but, I will, with much pleasure, state to you the impression thus made upon me at the time, and which the lapse of half a century has not yet effaced. Dr Monro primus, who had long filled the Anatomical Chair, with reputation to himself and advantage to his country, began the course of lectures in the autumn of the year 1758, and after delivering the history of Anatomy and some introductory lectures on the blood, and other general subjects, resigned his situation to his son, who, it must be acknowledged, from his father's great popularity as a public teacher, had an arduous duty to perform. He very soon convinced the public, that he was equal to the task, and the students were far from regretting the change that had taken place.

"Dr Monro primus had embraced the doctrine of Leeuwenhoek respecting the blood, and taught it to the last. Your father's first lectures were employed in giving a complete refutation of this system, which was placed on the shelf for ever. He clearly proved, that the different parts of the blood were permanently and essentially distinct from each other, and entirely independent of any aggregation or combination of globules. The novelty of a doctrine of so much importance in all physiological and pathological reasoning, with the clear and luminous manner in which it was explained, operated like an electric shock on the audience, and gained him a degree of confidence, which I believe no young man ever had at starting, but which his talents were well calculated to support. The students perceived in the other parts of the anatomical course, the same clearness of demonstration, acuteness of dissertation, and accuracy of reasoning, that they admired in his refutation of Leeuwenhoek's system. They could not help observing, that he was complete master of his subject; but that he possessed in an eminent degree another talent no less necessary for a public teacher,—the proper mode of communicating his own knowledge to others. Your father enjoyed likewise, when he entered upon his public duty as a professor of anatomy, a great advantage over all his predecessors, from the high improvements made at the time in anatomical preparations, particularly from the art of injecting the bloodvessels, and corroding the parts thus injected; by means of which he was enabled to elucidate more completely than could formerly be done, their numerous ramifications and communications.

" Your father enjoyed also a pre-eminence over most other teachers of anatomy, from the use he made of mathematical calculations or diagrams, to illustrate the effect of compound muscular action. He applied this particularly to the action of the intercostal muscles, shewing the advantage arising from their oblique course. His reasoning on this subject, with a diagram which I copied at the time, I have still in my possession.

" But the prominent feature of your father's anatomical course, and where he shone with no borrowed lustre, was his preparations and demonstrations of the lymphatic vessels. Whether he or his celebrated cotemporary, Dr WILLIAM HUNTER of London, is entitled to the praise of their first discovery, is a point still, I believe, undecided; and I am very far from having the presumption ' tantas componere lites.' But whatever difference of opinion there may have been on this subject, there can be but one opinion respecting the high merits of both claims, and the just praise to which they are entitled, for the zeal and success with which the subject was prosecuted and illustrated by both of them.

" The above observations, you will perceive, are entirely confined to the time I attended your father's lectures, which was from the autumn 1758 for the four or five following years. His subsequent discoveries respecting the communication between the lateral ventricles of the brain—bursæ mucosæ, &c.—I leave to you and other professional gentlemen to explain and appreciate.

" But before I quit this subject, I have one more remark to make.

" Your grandfather laid the true foundation of anatomy, and of his fame, in his accurate description of the bones, upon which your father has erected a trophy that must carry his name to the remotest ages, so long as the science of anatomy is cultivated among men.—Yours,

"J. CARMICHAEL SMYTH."

SELECTIONS FROM NOTES TAKEN BY DR ROBERTSON FROM DR MONRO'S LECTURES ON SURGERY.

"*Inflammation.*—Dr MONRO agrees with BOERHAAVE, that there is an *error loci,* or, in other words, that the red blood is forced during inflammation, into vessels whose calibre, in the healthy state, does not admit red particles. Dr MONRO'S theory of inflammation is, that it is a violent reaction produced by any stimulus applied to the bloodvessels. Dr MONRO enumerates *scirrhus* as one of the terminations of inflammation. He is quite convinced of this, although it has been denied by some late authors. He considers *scirrhus of the mamma,* occurring in females when they cease to have the catamenia, as owing to *plethora* of the system, acting on a part so tender as the mamma. He recommends females, at that period of life, to live most abstemiously, and take occasional laxatives. Scirrhus, at first, he thinks, is quite local; but, nevertheless, a taint of blood may, in some instances, be a cause.

"*Gonorrhœa.*—Dr MONRO thinks the virus producing gonorrhœa and chancre is the same; but that, in the former, the poison is mitigated, or partially neutralized, by the mucus of the urethra.

"*Gall-bladder* is occasionally wounded. In such circumstances, Dr MONRO thinks it practicable to throw a ligature round the *ductus cysticus,* to prevent the fatal effects that would be sure to arise from the bile being effused into the cavity of the abdomen.

"*Hæmorrhage.*—In throwing a ligature round an artery, Dr MONRO recommends us only to tie a *half*-knot, which he says is perfectly sufficient to stop the bleeding of any artery, the femoral not excepted. The advantage of this plan is that, if the bleeding returns, we can draw the knot tighter, without any fresh operation.

"*Lues Venerea.*—Dr Monro holds, that the venereal virus sometimes lies concealed in the blood for five, six, or even seven years, and then produces its usual effects. Mercury is supposed by some to kill or neutralize the virus as acids do alkalies; others contend that it throws the poison out of the constitution, by opening or dilating the mouths of the small excretory vessels. Dr Monro advises the mercury to be killed in honey, and taken internally. The ointment should be rubbed on the leg and thigh of the side where there is a bubo, and also on the organs of generation, and *above the ossa pubis as high as the umbilicus,* that the mercury may pass through the diseased glands. It should be rubbed in such quantities as to produce a pretty severe ptyalism. Some authors advise mercury to be used only in such small quantities as to produce a slight irritation or soreness of the gums.* But the disease often resists these means, and very generally returns. In such instances, Dr Monro has often effected a cure by producing an *ample* salivation.

"*Vaccination.*—In attempting to explain the modus operandi, Dr Monro hazards a conjecture that the cow must *long ago* have received the infection of small-pox from the human species, and that the animal returns the infection, but in a very *mild degree.*†

He also observed, that the variolous or vaccine inoculation does not secure, according to Heberden, the patient against the chicken-pox, which from analogy we should be apt to suppose it should do, and I have seen various examples of chicken pox appearing soon after variolous or vaccine inoculation. This is to be attended to, as it proves, in the first place, that the common and chicken smallpox are different diseases, and not different degrees of the same disease; Second, It explains the cause of an error of some persons, who have mistaken the chicken-pox for the smallpox, and have therefore affirmed, that the inoculation of the cow-pox did not prevent the person from being afterwards attacked with the small-pox.

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* "What would the venerable Professor have said to the modern system of *curing* lues venerea without any mercury at all?—A pernicious experiment, which has perilled, and absolutely ruined, many constitutions. A. R., *May* 1839."

† This has been signally verified by some interesting experiments of Ceely of Aylesbury during the last year. A. R.

"*Hydrocele.*—In operating for hydrocele, Dr Monro recommends the trocar to be pushed first through the skin, then upwards along the cellular membrane, and lastly, through the tunica vaginalis. The cellular membrane will thus act as a valve, after the trocar and canula are withdrawn, and so prevent undue inflammation from the admission of the external air. He advises port wine *undiluted*, and perfectly *cold*, to be injected into the sac, and to be retained there a quarter of an hour. Dr Monro never saw a case, treated in this manner, fail of a radical cure.

"*Hydrothorax.*—Where medicine fails, we are warranted in evacuating the fluid by puncture, the same as in ascites. With a view to producing a radical cure (by means of adhesive inflammation), we may admit *air* into the thorax by the canula, and expel it again by means of a full inspiration. Dr Monro thinks it justifiable to inject port wine into the cavity of the chest, the same as in hydrocele. Dr Monro has tried the injection of port wine in the lower animals. In his last experiment, the animal (a pig), survived it, though the injection was repeated on the opposite side of the thorax. Dr Monro says, little or no inconvenience is produced by adhesion of the lungs to the pleura costalis.

"*Piles.*—For the removal of hæmorrhoidal tumours, Dr Monro prefers the ligature to the knife or scissors.* We should seize the opportunity, when the patient is at stool, to pass a needle through the tumour.

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* As justifying this preference, I may mention a case, where a fine athletic young man, a friend of my own, died of hæmorrhage from a pile, *cut off* by an eminent London surgeon. A. R.

" *Cataract.*—Dr Monro prefers the operation of extracting the lens to that of couching, because the retina comes forward as far as the lens, near to the iris, and it is impossible to introduce a couching-needle into the lens without wounding and lacerating the retina more or less; besides, couching is only a palliative, whereas extraction is a radical cure. Dr Monro recommends the incision, preliminary to extraction, to be made in the *upper* part of the cornea,—not in the *under*, because any speck that might remain after the operation would occasion more inconvenience to sight on the under than on the upper part of the transparent cornea.

" *Amputation.*—In amputating the humerus, we should, when we cut the flexor muscles on the inside of the arm, keep the arm extended: and, on the contrary, when we cut through the extensor muscles on the outside of the arm, we should keep the arm bent. This method will preserve the muscles on the stretch while cut. They will, in consequence, retract more freely, and a greater quantity of muscular substance will be gained for covering the stump. We should save as much of the periosteum as possible, this membrane being of very great importance in the reproduction of bone, and its destruction being followed by troublesome exfoliations. When we amputate for diseases of the ankle-joint, the patient should be ordered to set the sole of his foot upon the ground. We should then take a string, and stretch it from the lower part of the patella to the sole on the ground: the exact middle of the string is the place at which the bone should be sawed.

" In amputating the thigh, extend the knee before dividing the muscles. This will throw them on the stretch; so that, when cut, they will shrink and retract more readily, and thus form a better covering to the end of the divided bone.

"*Fractured Cervix Femoris.*—This is an injury always difficult to manage. By proper machinery, the fractured bone must be retained in its situation, and the knees of the patient must be very steadily kept together by bandages, or, as Dr MONRO suggests, by *plaster of Paris.*[*]

Of Herniæ.[†]

"*Hernia.*—In trying means of reduction, the pressure should be gentle, and made, not with the palm of the hand,

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[*] Much diversity of opinion has prevailed as the re-union of a fracture of the neck of the thigh-bone within the capsular ligament. I have seen, as ROUX has observed, the neck of the thigh-bone shortened or deformed after its re-union. The French surgeons affirm, that a re-union of the fractured neck of the thigh-bone takes place. Sir A. COOPER denies it.

[†] The anatomy of the parietes of the abdomen and pelvis being now well understood, in consequence of the investigations of Dr P. CAMPER, GIMBERNAT, Mr A. BURNS of Glasgow, SCARPA, Sir A. COOPER, LAWRENCE, CLOQUET, and others, much light has been thrown upon the position, varieties, and mode of treating different herniæ.

The most common kinds of herniæ are the *inguinal, crural,* and *umbilical.* There are four varieties of the inguinal herniæ, in three of which, the tumour is external to the walls of the abdomen.

In the 1*st*, a most frequent kind, the protruded bowels fill the track of the inguinal canal, and follow an oblique course, and as the spermatic duct is larger than the round ligament of the female womb—men are the more frequent victims of this form of the disease.

The 2*d* form of inguinal hernia has been called the *direct*, as the protruded bowels pass only through the lower abdominal aperture, and in the 1st form of the disease the epigastric artery is on the pubal, but in the 2d, on the ileal side of the tumour.

In the 3*d* kind of inguinal hernia, the external tumour is situated in the same place as a crural hernia, owing to the want of the small tendinous fibres which connect the columns of the external oblique muscles. This kind of hernia is very rare, and I believe I have published the only representation of it.

In the first variety, when the bowels are protruded through the inguinal canal, and pass in front of the spermatic cord, these are directed obliquely downwards and inwards; they are covered, and the membrane derived from the tendon of the external oblique muscle, which has been but with the fore and middle fingers of one hand, and in the direction of the *centre* of the ring. Dr Monro says,

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called the *Superficial Fascia,* by the infundibuliform fascia and cremaster muscle, cellular tissue and skin.

In the second variety, no part of the tumour is oblique, and the internal oblique and transverse muscles pass across the neck of it.

As the inguinal apertures are extended in consequence of the bowels passing repeatedly through these, the *Upper Inguinal Aperture* may be so much enlarged, as to be brought immediately opposite to the *Under Abdominal Aperture;* and, in such a case, no part of the hernial tumour has an oblique direction, for it passes directly through the parietes of the abdomen.

As there is fat around the *Under Abdominal,* and also at the *Crural Aperture,* if there be an unusual quantity of it in such a situation, it may bear a strong resemblance to a hernia; and should colic, constipation, and vomiting follow, the case may erroneously be supposed to be a strangulated hernia.

On account of the connection of the crural arch with the neighbouring fasciæ, when we wish to relax as far as possible the superficial fascia, and the inguinal canal, to take off the pressure and stricture upon the displaced intestine, it is necessary to raise the head and pelvis of the patient (who is supposed to be in bed) with pillows, to bend the thighs very considerably, and to throw the knee of the affected side over to the opposite side, leaving only sufficient space for the surgeon to introduce his hand. On attempting to reduce such herniæ, the pressure should be made in the same direction as the hernial tumour; that is, in a recent inguinal hernia, the pressure should be made in the direction of the anterior spinous process of the os ilium; and in a hernia of some duration, directly upwards, as the *Upper* and *Under Parts* of the *Inguinal Canal* are, in such a case, nearly opposite to each other.

Unless the truss shall make pressure, not only upon the *Under,* but also upon the *Upper Abdominal Aperture,* the inguinal hernia will not be removed; and, a truss which presses only upon the *Under Aperture,* instead of affording relief, exposes the patient to strangulation at the *Upper Abdominal Aperture,* or between the *Upper* and *Under Abdominal Apertures.*[1]

[1] In justice to my Father, I cannot forbear describing a Truss for an Inguinal Hernia, which he directed to be made many years ago, and which several of his patients have worn with much benefit.

The cushion of the common truss is so small as to cover one of the Apertures only, and, from its thinness, when the circular is tightened with the view of increasing the pressure on the aperture, the pad is raised forwards from the aperture, because the ossa ilia and ossa pubis are more elevated than it, in consequence of which the truss does not produce the desired effect.

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that if he could not succeed in reducing the hernia in five or ten minutes, he would desist, for fear of the continued

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In the *4th* variety of inguinal hernia, the displaced bowels do not appear externally, but are placed between the upper and under abdominal apertures, forming a small rounded tumour which lies in front of the spermatic cord.

Of crural hernia.—The precise situation of this hernia was, I believe, first pointed out by GIMBERNAT of Spain.

On account of the connection of the ilial and transverse fasciæ with the crural arch, the bowels can be protruded only through the foramen crurale ; and, from the greater size of the female *crural aperture*, the greater width of the female pelvis, a smaller size of GIMBERNAT's ligament, and of the iliacus internus and psoas muscles, women are more exposed to crural herniæ than males.[1]

From the small size of the *crural aperture*, and unyielding nature of the parts around it, strangulation is more common in this kind of hernia than in the inguinal, especially in the male.

The bowels in crural herniæ are frequently protruded in a direction perpendicular to the abdomen, and on the fore part of the pectineus muscle; and, on account of the small size of the *crural aperture*, and unyielding nature of the parts in the vicinity of it, the neck of the tumour is but of a small size, nearly of an uniform diameter, and from half an inch to three-quarters of an inch long. On account of the quantity of cellular substance at the bend of the thigh, which yields readily, and on account, also, of the falciform process of the fascia lata, the tumour, in a case of crural hernia, does not descend, but is often reflected, or, as I in my Observations on Crural Herniæ observed, tilted upwards upon the crural arch, so that the fundus of it is in the most prominent part, and the body and neck of the sac form a considerable angle with each other; and the tumour sometimes expands literally to a considerable extent.

Owing to the superficial fascia, the quantity of fat, cellular substance, and lymphatic glands, which cover a crural hernia, it is very difficult to detect that disorder, which may very readily be mistaken for a swelling of the lymphatic glands, as a crural hernia may exist at the same time as a swelling of these glands ; hence the surgeon must judge of the na-

He therefore directed, that the pad of the truss should be made much thicker and larger, and placed with such a degree of obliquity, with respect to the circular, as to press upon both apertures at the same time.

[1] Sir A. COOPER in his valuable work on Crural Hernia, p. 4, London 1807, has observed, " The difference in the structure of these parts in the male and female, which chiefly conduces to the production of crural hernia, is well explained by Dr MONRO jun. in his observations on Crural Hernia."

handling of the tumour bringing on gangrene. Ice or snow should never be applied to the hernial tumour, as the

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ture of the disease, by the history of the symptoms, as much as by the knowledge he gains by examining the tumour with his fingers.

From the connection of the fascia lata with the tendon of the external oblique muscle, it is obvious, that if the thigh be extended, the crural arch must be put upon the stretch; and, on the other hand, when the thigh is rotated inwards, and raised nearly to a right angle with the body, the external arch is relaxed; hence the pain which the extending the thigh creates in some cases of crural hernia.

In many cases of crural hernia, the stricture is so complete, that the surgeon finds great difficulty in introducing even the nail of his finger as a director. On account of the situation of the epigastric artery, and occasionally of the obturator artery, in respect to the hernial tumour, the division of the tendinous fibres is made with the greatest safety on the pubal side of the tumour.

As, in our erect posture, the bowels gravitate directly against the *crural aperture*, there is less chance of removing a crural than an inguinal hernia, by the use of a well-made truss.

There are several varieties of this kind of hernia.

1*st*, The most common kind of crural hernia is that in which the bowels is protruded through the crural aperture into the lymphatic sheath, which is thereby much distended and protruded.

In this instance, the hernial tumour is situated on the pubal side of the femoral vein, and is covered by the fascia propria of Sir ASTLEY COOPER, which is rather thicker than the healthy peritoneum under which a small quantity of fat is found between it and the hernial sac.

The neck of the hernial tumour is covered by the upper insertion of the falciform process of the fascia lata: the epigastric artery is situated on the ilial side of the tumour, and about an inch from it.

In the *second* variety of crural hernia, the protrusion of the bowels takes place through an aperture in the membrane which passes across the crural aperture; a lymphatic gland which had filled up that aperture having been displaced, and pushed to the ilial side of the crural hernia.

The stricture, in this instance, is sometimes occasioned by the sides of the aperture through which the protruded intestine had passed. This variety is peculiar in wanting the fascia propria.

The *third* variety of crural hernia is that in which the protruded bowels pass into the sheath surrounding the femoral lymphatics, and then escape by one of the apertures, through which the lymphatic vessels enter the sheath, as has been accurately described by Sir A. COOPER.

great degree of cold might also bring on gangrene. But as cold suddenly applied to the abdomen has been known

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The tumour has not a well defined edge, being covered by the fascia lata of the thigh.

In this hernia, the strangulation may be occasioned by the border of the sheath.

The *fourth* is that variety of crural hernia where the tumour passes through the ilial side of the lymphatic sheath, into the sheath of the femoral vein.

The hernial tumour is originally situated on the pubal side of the femoral vein, having the semilunar fold of the fascia lata stretched across its neck: the epigastric artery is situated on the ilial side of the swelling, and its termination is placed in the front of the femoral vein, distending the sheath of that vessel.

In the *fifth* variety of this disease, there are two tumours; the one escapes into the sheath of the vein, the other into that of the lymphatic vessels.

In this instance, the obturator artery passed between the hernia, and encircled the tumour next the os ilium.

The *sixth* is a frequent variety of crural hernia. The displaced bowels, in the first place, descend in a direction perpendicular to the abdomen, and lie over the pectineus muscle; the tumour is therefore very moveable. In consequence of the connection of the falciform process of the fascia with Poupart's ligament, and the duration of the disease, the tumour is frequently reflected over the crural arch, and is covered by the superficial fascia, skin, and cellular substance only.

From the great looseness of the cellular substance at the sides of the tumour, it extends laterally, the transverse being the longer diameter. This kind of hernia sometimes attains a considerable bulk; my father met with a case in which the hernial tumour was in size equal to both his fists.

In this variety of hernia, the sac is remarkably thin, so that the vermiform contractions of the protruded intestine are visible; the neck of the tumour forms nearly a right angle with its body.

In the *seventh* variety of crural hernia, the protruded bowels primarily enter the sheath of the lymphatic vessels, and then pass through holes for the transmission of lymphatics in the cribriform fascia, and in the falciform process. The tumour is in a great measure immoveable, and bears a very strong resemblance to an enlarged inguinal gland. The history of the tumour, its situation, and its appearance in the erect, and disappearance in the recumbent posture, distinguish this disease.

The *eighth* variety of crural hernia cannot be distinguished by an external examination. In this, the obturator artery arises from the same sometimes to produce a stool where all other means have failed (for instance, in certain cases of Ileus), Dr Monro advises us, with a view to promote so desirable an event, and at the same time to avoid the risk of gangrene, to apply the cold suddenly to the *back*. When the operation for hernia is resorted to, Dr Monro reprobates the opening of the sac, because the exposure of the bowel to the air produces the most imminent danger. It should be returned into the abdomen unopened, as soon as the fibres producing the strangulation are divided.

" The above selections from my notes (says Dr Robertson) might, if time and space permitted, be much extended. My object, however, has been to give a specimen of the practical tone of your illustrious father's lectures, rather than to condense (which indeed would have been impossi-

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trunk as the epigastric artery. The common trunk being an inch long, the obturator artery, in its course to the obturator aperture, encircles the neck of the hernial tumour on its *pubal side.* I have met with three cases of this description.

In my book on the Morbid Anatomy of the Gullet, Stomach, and Intestines, I have described at length the position of the hernial tumour in relation to the neighbouring nerves and bloodvessels.

When the obturator artery arises, in common with the epigastric, which occurs in one of twenty cases,[1] that artery, if the common trunk be long, is in danger of being divided, if Gimbernat's ligament (the most common cause of stricture in crural hernia) be divided, and considering the size of the obturator artery, its deep situation, and the difficulty of securing it by a ligature, so large a quantity of blood might be lost as would prove fatal.

To the *navel rupture,* infants with large navel strings, and women who have borne a number of children at short intervals, are frequent victims. On a former occaison,[2] I endeavoured to combat the opinion, that such herniæ are destitute of hernial sac, in which Mr Lawrence and others have subsequently concurred.

Scarpa has faithfully described the different kinds of this hernia, which often attains in pregnant women a large size.

[1] I was much gratified to observe that Velpeau, a very distinguished surgeon, coincides with me in this opinion.

[2] Vide Observations on Crural Hernia, Edinburgh 1803.

ble in a communication like the present) the vast variety of information which they conveyed.

"On the admission of air into shut sacs and cavities that do not naturally contain it, your father entertained very strong opinions. The pernicious effects of air under such circumstances is, I believe, more or less admitted by all modern physiologists and practical surgeons. But your father inculcated the danger of it in the most strenuous, authoritative, and emphatic manner. He laid it down as the result of his experiments on the lower animals, that the exposure of the abdominal viscera to the atmospheric air, even for fifteen minutes, is sufficient, in most instances, to produce death. Hence he deduced the necessity of the practice, which he so strongly advocated, of returning the herniary sac into the abdomen unopened. His arguments on this subject made an indelible impression upon me; and, some years afterwards, while I held the appointment of surgeon in the Royal Navy, I ventured to concentrate my thoughts upon the matter, and bring them before the public. From my limited reading at that time, I was not aware that your father's ideas had already been published to the world, in the most authentic shape, in the Appendix to your valuable Observations on Crural Hernia. I drew up a paper, and transmitted it to Dr DUNCAN Junior, for publication in the Edinburgh Medical and Surgical Journal. Being then a very young man, and fearing it might be thought I was guilty of presumption in seeking to *teach*, while I ought still to be anxious to *learn*, I requested as a favour that my communication might appear *anonymously*. It appeared accordingly in the Number of the Journal for July 1814 (page 290), under the title of "THE INQUIRER;" and I shall here subjoin a copy of it, as it brings the details of your father's proposal, and the powerful arguments with which he enforced it, completely into view.

" '*Remarks on the advantages of returning the Hernial Sac unopened into the Abdomen.*

> ——————————— " omnes
> Admonet, et magna testatur voce per umbras;
> Discite justitiam moniti, et non temnere Divos." *
> VIRGIL, *Æneid*, Lib. vi.

" ' After the very able treatises which, of late years, have appeared on the subject of hernia, it may probably appear a singular degree of hardihood to start any objections against the practice so universally followed, and sanctioned by so many great names.

" ' It would be easy to prove, that the authority of great names has sometimes exerted a debasing sway over the progress of knowledge. Few need to be reminded that a supine submission to the dogmas of ARISTOTLE, and a superstitious veneration for his doctrines, merely *as his*, contributed to retard the advancement of science as much perhaps, as the Cimmerian darkness of the Gothic ages.

" ' The several excellent observations on the subject of hernia, with which the world has lately been favoured, were surely never intended to set all inquiry at rest; on the contrary, it strikes me as being their chief praise, that they have stimulated the general body of the profession to a more accurate anatomical knowledge of the parts concerned, and a more minute investigation of the whole subject than heretofore.

" ' The proposal which I am about to disclose has long dwelt upon my mind, and been the subject of much reflection. Several years ago, when I was an attendant on the medical lectures in the University of Edinburgh ('Templa quam dilecta!') Dr Monro *Senior* delivered from his place a variety of remarks on the propriety of returning the herniary sac into the abdomen unopened. I listened with the greater eagerness, as it happened that the observations of the Professor exactly coincided with an unfledged idea to which my own mind had given birth, but to which I had never ventured to give utterance, being, at that time, entirely without the benefits of experience, and of more extended views. Even at this distance of time I can well recollect how forcibly I was affected by the reasonings, cogent in themselves, and enforced with all the eloquence and impressiveness of a professor venerable for his years, and of the gravest authority from his talents, from his station, and from his multiplied opportunities of experience. I am anxious to embody the hints furnished by my note-book, brief and inadequate as they are, together with the result of my reflections since the period alluded to, and transmit them in this shape, seeing no other likely way of the subject coming before the profession.

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* " Perhaps the above motto, rendered literally, may be considered too strong and decided; but I wish it to receive a free translation, like the following: ' *From the shade of concealment*, he addresses *all*, in a distinct tone, to this effect;—estimate these observations by their *justness* only; and do not spurn sound arguments—the deities that ought to preside over, and direct, every conviction."

"'The words of Hippocrates, "ὁ καιρος ὀξυς, ἡπειρα σφαλερη," may be justly repeated of hernia in a state of strangulation; the crisis is indeed most important, and the attempt at relief by operation, in the extreme hazardous. But here it fortunately happens, that we are fully aware of the source of danger; for every surgeon is sensible, that in all instances where death takes place after the operation, it is owing to inflammation of the intestines or of the peritoneum (the latter most frequently), having supervened to its performance.* This applies to those cases where the operation is performed under the best auspices, and where it has been resorted to before gangrene takes place in the strangulated portion of intestine.

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* "Very often inflammatory symptoms are set on foot *before* the operation, from the patient having refused to submit to the latter in proper time. This is my opinion founded upon farther experience. A. R. *May* 1839."

" ' After all this, can it be wondered at if abdominal inflammation so often comes on and kills the patient ? Do not experiments on brute animals prove the pernicious effects of air in exciting inflammation on abraded surfaces, and parts naturally secluded from its action ? The sac being a portion of the peritoneum, must not the inflammation, resulting from so large an incision of the sac, rapidly creep upwards, and diffuse itself over the whole reduplications in the abdomen. Is not such wont to be the progress of inflammation in membranes ? Considering the previous disorder of the *primæ viæ*, and in fact of the whole system, must not the farther violence done, during the operation, to a portion of the canal, be a most powerful cause of a fatal enteritis ?"

" ' These questions admit, I think, of but one answer ; and I cannot withhold my opinion, if, in all cases, violent inflammation does not take place after the operation, the happy circumstance is chiefly owing to the free detraction of blood previously practised as part of the *Taxis*.

" ' Surely any surgeon would, at all times, be willing to reduce the hernia without an operation, if it is practicable, and will think it perfectly safe to do so. When, therefore, the operation is had recourse to in due time, what new reason makes a change of plan necessary? Why will he open the sac *now*, when he would most willingly have reduced it but a few minutes before, by the means usually called *taxis ?* Surely there is a manifest inconsistency in such a mode of procedure ; and although a practitioner may screen himself from censure under the broad canopy of general usage, I suspect he will not be able, without sophistry, to elude the unsatisfied inquiries of his own conscience.

" ' I again repeat, that the above observations proceed all along upon the supposition that the operation has been performed in due time ; for if the strangulation has been of such continuance as to render it more than probable that mortification of the protruded gut has taken place, then, beyond doubt, the sac must be opened, for the obvious and intelligible purpose of removing the gangrenous portion, and affording the patient a chance of being saved.

" 'That inflammation should be so frequent and so fatal an occurrence, will not excite surprise, when respect is had to the condition of the parts immediately before, and during the operation. Probably, for many hours, the strangulated portion of intestine has been gorged with blood, and if not in a state of actual inflammation, is at least in a state that we may consider fully prepared, from the slightest additional causes, to take on that action. Besides, during this time, the parts have been farther irritated by handling, by pressure, and by local applications, now hot, now cold, to the tumour. Still it is irreducible; and we shall suppose the operation proceeded to without more delay. What now takes place? The surgeon divides the integuments by a wound several inches in length, and then proceeds, by an incision of similar magnitude, to lay open the sac. After the viscera, thus unhallowedly exposed to the pernicious stimulus of a *medium* unusual to them (viz. the atmospheric air), have been duly felt, fingered, turned over, and examined *secundum artem*, the next step is to divide the stricture, which really one might suppose, *a priori*, to be the first object in view. The protruded bowels are at length reduced, but not until, in all probability, they have been brought into rude contact with a number of irritating substances, such as sponges applied to the wound, the fingers of the surgeon, or perhaps the sleeves of his coat!!

" 'The following, then, is my humble proposition: When called to a case of strangulated hernia, the first step to be taken is, to place the patient in a proper posture, to relax the femoral and abdominal muscles, and to apply judicious but *gentle* pressure to the tumour; at the same time that an assistant squeezes upon it, from a sponge, the very coldest water that can be procured. Should this fail of success, let the patient be bled to syncope, and the same means assiduously renewed at the favourable moment of *collapse.* Should this too fail, a cathartic enema (*not of tobacco*) should be forthwith injected. Purgatives by the mouth are ever pernicious, because, even were the state of the stomach such as to retain them, their only effect would be to aggravate the evil, by forcing down a quantity of *flatus* through the upper portion of intestine into the tumour.

" ' Allowing the enema a reasonable time to operate, let the efforts at reduction be renewed ; and should they still be unsuccessful, it may be fairly pronounced that the patient has no chance but from an operation ; and, therefore, every minute that is allowed to pass in further temporizing and delay, carries away with it, beyond recall, a chance from the unfortunate sufferer. I think all the steps above recommended might, by an active practitioner, be fairly put in force in *one hour at the utmost.* Should a trial so energetically conducted fail, the operation ought to be instantly resorted to, as farther attempts at reduction in the present posture of things, is too often productive of much ensuing evil.

" ' Let the integuments be divided in such a manner as freely to expose the upper part of the hernial sac. *Without laying it open*, let the finger be gently insinuated along its neck ; the fibres producing strangulation will now be felt, and may be divided in the usual manner. This being done, it is obvious that very gentle pressure applied to the sac will now be sufficient to return its contents into the abdomen.

" ' The manifest advantage of this mode is, that a most formidable, and often fatal, operation will be converted into a simple incised wound of the abdominal parietes. The risk of subsequent visceral inflammation would be so comparatively small as scarcely to be the subject of reasonable calculation.—' *Utrum horum mavis, accipe.*'

" ' The only objections of which I am aware are, the probability of the strangulation being occasioned by a *frenum* passing across the mouth of the sac; or a quantity of fetid fluid being accumulated in the bottom of it. As for the latter, I think, no harm can result from the whole contents of the sac being replaced in the abdomen; as the water would soon be absorbed. As for the former case, the cause of strangulation will be readily ascertained when the integuments are divided; and should it appear to be something in the mouth of the sac itself, a small opening may be made in its neck, just sufficient to admit of the obstacle being divided. But, I believe, the existence of a *frenum* is not found more than *once in a hundred* cases; and for such a rare occurrence to be pitted against the operation here recommended, could prove no more than that *one* mode of practice is not *universally* applicable.

" ' Surely enough has been said to render myself intelligible.

" ' I trust the above observations will be entertained in that spirit of candour in which I have written them. Be this as it may, the terrors of impending criticism do not deter me from communicating these peculiar, though possibly erroneous, ideas. Freedom of thought is a prerogative inseparable from *mind;* I feel it to be so, and within the limits of decorum, will assert it. ' *Dieu me l'a donnée; et diable ne me l'otera pas.*' My reason, such as it is, is only to be controlled by better reason; to which I am ever open, and ever most happy to listen. As for the above remarks, I am willing to flatter myself, that their being anonymous will not detract from their weight, should they be allowed to possess any. Had I communicated any *facts*, or made any *assertions*, my *name* might very reasonably have been claimed as a guarantee for my veracity. But, in what I have written, I have ventured no opinion without rendering a reason for it. I have not dealt in *assertions*, but in *arguments*, which may be judged of in themselves, and by themselves, independently of the person who urges them.

" ' An arrow discharged from the archer's bow, strikes with a force proportionate to the strength of the archer. So is it with *assertions ;* whose sole convincing power is derived from the name or fame of the *assertor.* But *arguments* are like arrows thrown from the cross-bow, which strike with equal force, whether they are let off by the hand of a pigmy, or a giant. They derive their powers of producing conviction, not from the adventitious circumstances of the reasoner; but from the intrinsic strength of *their own* materials.

" ' The sentiment is from Boyle; and I adopt it with all my heart.

" ' (*February* 1. 1814.)' "

" The foregoing anonymous, and very juvenile, production was criticised with some severity by Mr Penkivil of Plymouth Dock; it was also replied to, at some length, by Mr Edmonston of Newcastle-upon-Tyne. For the papers of these gentlemen, I must refer you to the Edinburgh Medical and Surgical Journals for October 1814, and for January 1815. I did not deem it expedient, or becoming in me as a young man, to pursue the controversy; and, therefore, I suffered the subject to drop. But since that period, I have thought much on the matter; and within these few years, a case has been communicated to me, which contains, I must candidly own, a stronger argument for laying open the sac, *and carefully examining the intestine*, than all the reasons put together of the opponents of your illustrious father's plan. The case I mean is, where the pressure of the ring, *during strangulation*, has produced an accretion of the sides of the intestine to each other, by means of adhesive inflammation; and where there is a consequent obliteration, for a considerable space, of the calibre of the bowel. A case of this kind occurred in 1817, in the practice of the late Dr Bishopp, who related it at full length in his Inaugural Dissertation, published at Edinburgh in the year 1822. As the case is a very unusual one, and as Dr Bishopp's very interesting Thesis (' De Hernia Enterocele Acuta') may not be accessible to many readers, I shall here give an outline of it. A healthy young man, in his twentieth year, was taken with symptoms of strangulated hernia on the 27th of March. It was bubonocele ; the tumour consisted solely of intestine. Every attempt at reduction having failed, Dr Bishopp proposed the operation ; but the patient refused to submit to it till the 31st, when the strangulation had continued more than four days, and when, of course, the circumstances had become desperate. He died twenty hours after the operation. On dissection, the intestine (a portion of the ileum) was found to be completely obstructed in its calibre, its sides having become firmly glued together, under the stricture formed by the abdominal ring, for the space of an inch and a half. The intestine, thus obstructed, presented nothing peculiar to the eye or touch ; except some greater degree of thickness and firmness than usual, together with an immobility of its parietes. Dr Bishopp presented the portion of intestine which was the subject of this memorable adhesion to Sir Benjamin Brodie ; neither that eminent surgeon, nor yet Sir Astley Cooper, having ever (as they assured Dr B.) met with the like case.

" Dr Bishopp, in an appendix to his Thesis, narrates a somewhat similar case, that occurred to Ritsh, and which is recorded in the Mémoires de L'Academie de Chirurgie ; tom. iv. p. 173."

A. Robertson, M. D.

I now proceed to give a short notice of the different books which my Father published, to which I shall subjoin extracts from his lectures, and a few additions of my own, beginning with Dr Monro's Observations on the Structure and Functions of the Nervous System, published, Edinburgh, 1783. The first circumstance regarding this book which merits notice is, that, within the last forty years, several very important discoveries as to the functions of the nerves have been made, more especially by Sir C. Bell, who with great candour has acknowledged,* that these were suggested to him by my father's description of the ganglion of the fifth pair of nerves, by the fact of the same muscle of the face being supplied by two nerves, and by the very peculiar origin of the roots of the spinal nerves, which is as follows: "When we carefully trace the anterior and posterior bundles which form the spinal nerves, we shall find, that each has its proper sheath in the dura mater, and from the inner layer of the dura mater its proper sheath, or that between the two bundles, which form the spinal nerves, a portion of dura mater intervening on the outer side of the sheath of the dura mater, the cellular substance condensed, ties the two bundles together, so that, at first sight, they appear like one nerve. Hence authors have described them as passing through one hole, as forming one nerve terminating in a ganglion. But when we break the cellular substance which connects the two bundles, it will be found *that* the posterior *only ends in the ganglion, and the posterior bundle has not its nervous fibres incorporated with those of the anterior bundle, till it has passed through the ganglion.*"

It is remarkable, that Dr Monro secundus, who had accurately described the spinal nerves, had not discovered their functions:† and more especially as he had stated, that the connection of the accessary nerve with the posterior roots of the first and second cervical nerves, is an equivalent for a posterior root.

The nervous and muscular tissues being essential to the vital functions, probably exist in all animals, though, on account of their extreme minuteness and transparency, they escape our observation in very small animals. It seems also probable that the sensorial power is more or less perfect in different classes of animals, being adapted to their wants and necessities, and therefore is more imperfect in the lower grades, their food being derived from the air and water which surround them; whereas animals higher in the scale of being require a larger share of sensorial power, their food being obtained by an act of volition. In order to arrive at an accurate knowledge of the structure and functions of the brain and other parts of the nervous system, it is necessary to begin with the lower animals, where it is of the simplest structure. Thus, the points of similarity or dissimilarity between the component parts, become obvious; thus, the additions made to it may be traced, and their relation to the degree of intelligence discovered. We thus discover that the brain is not proper to all animals, that the spinal chord and nerves are the most essential parts of the nervous system; that in the higher animals, brain is added; that the brain most gradually becomes larger, new parts are added; and that the human brain is most complex in its structure and functions.

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* *Vide* Report of Transactions of British Association for 1834.

† *Vide* Plate I.

It is foreign to the object of this book to describe the nervous system of different classes of animals; it is sufficient to observe, that EHRENBERG supposes he has detected the nervous system in the infusoria, and in the medusæ, red points, which he believed to be eyes. According to CLOQUET, nerves are distinctly seen in intestinal worms and in the acrita. Nervous molecules are dispersed through the homogeneous texture of the body.

The nervous system of the asterias has been accurately described and represented by TIEDEMANN. In the annelida, crustacea, and arachnida, a nervous circle, which is superior to the gullet, supplies the place of brain.

My friend and former pupil Mr SWAN has published very beautiful and faithful descriptions and representations of the nervous system of the crab, lobster, centipede, the cod, skate, turtle, frog, and boa constrictor.

In short, the nervous system, in its most simple form, is a chord or ring, from which small nerves issue out to the different parts of the animal; or there is a ganglion or brain above, or on the dorsal part of the gullet, from which the principal nerves are sent off on each side of the gullet, and a nerve passes to a ganglion situated below, or on the ventral parietes.

The ganglia vary in number, and their size is proportioned to the number of nerves sent off by each of them. Mr Swan observes, "the most exact adjustment of the nervous system to the parts of the skeleton, or other organs subservient to motion, has been made with a special view of securing ease. Without the most consummate skill in calculating the precise size and length, particularly the spinal marrow and nerves necessary for their adaptation to the moving parts, so as to prevent their overstretching, misery must generally have resulted from every combination."

In the slug and crustacea, a nervous ring, a substitute for brain, is distinctly seen, and two chords extending from it to the tail of the animal. For the last thirty years, I have exhibited the structure of the nervous system of the lobster; and it has lately been very fully and accurately described by Mr Newport (Phil. Transactions, 1834), who discovered in the nervous chords a motor and sensitive tract, to which latter, the ganglia are connected.

The nervous system of fishes presents the first appearance of a cerebro-spinal axis. In this case the anterior lobes of the brain are very small, being connected with the olfactory nerves. They have been called olfactory tubercles.

The optic tubercles are proportionably much larger than in mammalia and birds, but the lobes of the cerebellum are very small.

In the class amphibia, the cerebellum is very small. The brain of birds bears a very large proportion to the cerebrospinal axis. The corpora quadrigemina are small, as also the cerebellum.*

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* *Vide* Dr Carpenter's Physiology for a distinct account of the varied facts supplied by comparative anatomy as to the nervous system; Serres's Book on the Brain is also well worthy of perusal.

The following observations regarding the human brain were made by my father, after he had demonstrated the brain in the year 1804.

The different parts of the nervous system being of a very delicate structure, are well protected from external injury.

The brain and spinal chord are well protected in a bony case, the former by the skull, the latter by the spinal canal; the other nerves by their deep situation, and by the fat and cellular tissue in which they are imbedded.

After adverting to the adhesion between the internal surface of the skull and the dura mater, which is more intimate in children than in adults; to the anastomoses between the vessels of the pericranium and dura mater, owing to which the dura mater partakes of diseases of the pericranium, he observed, that surgeons should detach the pericranium as little as possible in performing the operation of trephining, and also that blood may be effused on the surface of the dura mater, in such quantity as may compress, in a dangerous manner, the brain.

He also remarked, that the blood-vessels proper to the dura mater are disposed on the surface of that membrane, and that the principal trunks are lodged in a deep canal of the skull, in order to prevent the brain from being affected by their bulk, or pulsation.*

My Father remarks that the human brain generally weighs between 3 and 4 lb.,† and he published figures re-

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Tiedemann's elaborate book on the progressive changes of the brain of the human fœtus during uterine existence should also be consulted.

* I have met with three examples of the canals for the vessels of the dura mater passing between the tables of the skull. May not a considerable quantity of blood be discharged, when the large veins passing through the diploe have been opened ?

† Much having been written regarding the comparative size and weight of the brain by Aristotle, Pliny, Buffon, Camper, Gall and Spurzheim, Soemmering, the Wenzels, &c., in which very different statements are given; I therefore requested the favour of my friend

presenting the magnitude and internal structure of the human brain, and that of the ox.

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and colleague Sir W. Hamilton to examine particularly the weight of the brain at different periods of life, of the different sexes, and different nations, and different animals; and he has favoured me with the following results, deduced from the examination of sixty human brains, about 300 human skulls of determined sex, the capacity of which, by a method he devised, was taken in sand, and the original weight thus recovered; and from more than 700 skulls of different animals.

"1. The adult male brain is heavier than the female; the former nearly averaging, in the Scots head, 3 lb. 8 oz. troy, the latter 3 lb. 4 oz., the difference 4 oz. In the male, about 1 brain in 7 is found above 4 lb. troy; in the female, hardly 1 in 100.

"2. In Man, the encephalon reaches its full size about seven years of age. This was never before proved.

"3. It is extremely doubtful whether the cranial contents usually diminish in old age. The vulgar opinion that they do, rests on no adequate evidence, and my induction would rather prove the negative.

"4. The common doctrine that the African brain, and, in particular, that of the Negro, is greatly smaller than the European, is false. By a comparison of the capacity of two Caffre skulls, male and female, and of thirteen Negro crania (six male, five female, and two of doubtful sex), the encephalon of the African was found not inferior to the average size of the European.

"5. In Man, the cerebellum, in relation to the brain proper, comes to its full proportion about three years. This antiphrenological fact is proved by a great induction.

"6. It is extremely doubtful, whether the cerebellum usually diminishes in old age; probably only in cases of *atrophia senilis*.

"7. The cerebellum, in the female, is in general considerably larger, in proportion to the brain proper, than in the male. In the human subject (the tuber excluded), the former is nearly as 1 to 7.6; the latter nearly as 1 to 8.4: and this sexual difference appears to be more determinate in man than in most other animals. Almost the whole difference of weight between the male and female encephali lies in the brain proper; the cerebella of the two sexes, absolutely, are nearly equal,—the preponderance rather in favour of the women. This observation is new; and the truth of the phrenological hypothesis implies the reverse.

"9. Castration has no effect in diminishing the cerebellum, either absolutely, or in relation to the brain proper. The opposite doctrine is an idle fancy; though asserted by the phrenologists as their most incontrovertible fact. Proved by a large induction.

"10. The universal opinion is false that man of all, or almost all

The following are his observations as to the circulation of the blood in the brain.

Of the arteries of the brain.—The brain receives its supply of blood by the medium of four arteries, the two internal, and two vertebral arteries.

In the first place, it may be observed, that obstruction is guarded against by the large and frequent anastomoses between their larger and smaller branches, and also by the frequent communications between the ramifications of the veins; and in proof of its effect, I found, in an experiment I performed with Dr Emmet, that, when both common carotid arteries of a dog were tied or cut, the functions of the brain were not impaired.*

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animals, has the smallest cerebellum in proportion to the brain proper. *Many* of the commonest quadrupeds and birds have a cerebellum, in this relation, proportionally smaller than man.

" 11. What has not been observed, the proportion of the tuber annulare to the cerebellum (and a *majore* to the brain proper), is greatly less in children than in adults. In a girl of one year (in my table of human brains), it is as 1 to 16.1; in another of two, as 1 to 14.8; in a boy of three, as 1 to 15.5; and the average of children under seven, exhibits the pons, in proportion to the cerebellum, much smaller than in the average of adults, in whom it is only as 1 to 8, or 1 to 9."

* Sir A. Cooper's experiments on the application of ligatures to the vertebral and carotid arteries of different animals are highly interesting.

The following are some of the inferences which Sir A. Cooper has drawn from his experiments.

The vertebral arteries are much more important vessels, as regards the brain and its functions in these animals,[1] than the carotid arteries. The nervous power is much lessened by tying them; and, in these experiments, the animal did not, in any case, survive the operation more than a fortnight, although I do not mean to say that recovery is impossible. In the dog also, the carotids may be tied with little effect; but the vertebrals have a great influence.

Compression of the carotid and of the vertebral arteries at the same moment, in the rabbit, destroys the nervous functions immediately. This is effected by the application of the thumbs to both sides of the neck, the trachea remaining quite free from pressure, when respiration entirely ceases, with the exception of a few convulsive gasps.

The same fact is evinced in a clearer and more satisfactory manner

[1] Mr Coleman informs me that the vessels of the horse are different; and he thinks it is designed to counteract gravitation, when the animal is feeding on grass.

In the next place, the internal carotid and vertebral arteries are larger in proportion to the size of the brain, than the arteries of other organs.

Drs Keill, Boerhaave, and Haller, have calculated that one-fourth or one-fifth, according to Dr Monro, one-twelfth part only, of the whole blood goes to the brain.

Dr Monro, after making observations upon the very peculiar manner in which the blood is circulated within the skull, used to add in his lectures the following observations upon sanguineous apoplexy.

" Many circumstances concur in proving that sanguineous apoplexy originates from the arterial system.

To this conclusion we are led, by considering the causes of the disease, the bodily form, age, and manner of life of the more usual victims of this disease.

Thus, intemperance disposes to apoplexy. Redness of the eyes, flushing and foulness of the face often precede the fit.

The pulse is often full and throbbing.

Short-necked persons are peculiarly liable to apoplexy, as the blood flows into the head with greater force than usual.

Corpulent persons are also the frequent victims of apoplexy, as the fat accumulated, and particularly in the abdomen, resists the freedom of circulation, and hence the blood flows with more violence into the arteries of the encephalon.

A debauch, violent exercise, vomiting, occasion apoplexy, by increasing the momentum of the blood suddenly, not only add to the compression of the brain by stretching

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by the application of ligatures on the four vessels, all being tightened at the same instant, when stoppage of respiration and death immediately occur.

When the dog is the subject of this experiment, it loses its volition and sensation, and appears as if it were intoxicated ; but the anastomosing vessels gradually restore the circulation, by means of the other branches of the subclavian artery at the back and sides of the neck.

the arteries, but often occasion a rupture of these and effusion of their blood on the surface of the brain, within its ventricles, or at the base of the brain.

On the contrary, venesection, or arteriotomy, prevents a fit; or, if a fit has come on, nothing proves more efficacious in affording relief.

But a sudden impulse of the blood has little or no effect in distending the veins and sinuses, nor can venesection empty them, as I shall endeavour to prove.

Apoplexy is therefore almost always occasioned by a rupture of the arteries of the brain, and old men are much more frequently seized with it than younger persons, or those of middle age, because, in the former, the coats of the arteries are thinner, less tough, and more easily ruptured; besides, their coats are very frequently rendered very tender, from having been partially ossified. But age brings about no change in the form or thickness of the coats of the sinuses, and they are seldom or never ruptured.

There is the clearest evidence, that a fulness of blood and tension of the vessels of the brain, without a rupture of them, may, by compressing its medullary substance, derange the functions of the brain, and give rise to symptoms of an apoplectic nature:—thus, many persons after stooping forwards for some time, become giddy, or are seized with a degree of stupor, dimness of sight—symptoms which are the frequent precursors of apoplexy. We cannot adopt the opinion entertained by most authors of great celebrity, that upon a post mortem examination of persons who have fallen victims to apoplexy consequent to exposure to a tropical sun, violent exercise, excessive vomiting, or intoxication, the vessels of the brain will be found so evidently dilated, as to account for the apoplectic fit and death of the person.

But this is so far from being true, that, unless there has been a rupture of the vessels and extravasation of the blood, no change whatsoever in the state of the vessels can be distinguished, because the medullary matter of the brain is not compressible like a piece of sponge or cork, the pores of which are filled with air. Unless the medullary matter of the brain could, by the force of the circulation, be squeezed into a smaller bulk, it is evident there can be no sensible and general dilatation of the bloodvessels.

To prove that the utmost force of the circulation is not capable of compressing the substance of the brain into a smaller bulk, I put large pieces of the brain into a glass decanter, which I filled with water up to the middle of its neck, I then tied an inflated bladder to the mouth of the decanter, and did not find, on squeezing the bladder, that the water sunk in the neck of the decanter, which it would have done, if the brain had been evidently compressible by such a force.

If it be granted, that the substance of the brain is as compressible, as what Mr Canton has found water to be, which is, that by twice the pressure of our atmosphere, or pressure of a column of quicksilver five feet in height, we could lessen its bulk $\frac{1}{20,000}$th part, or if we suppose the head to contain 20,000 drops of blood, and that we could lessen its bulk by the bulk of a single drop, surely this difference could not be distinguished by the eye.

Therefore, where blood is extravasated, it is most absurd to adopt the supposition, that the white substance of the brain was compressed into a much smaller bulk, or had lost as much of its bulk as was equal to the bulk of the blood effused, instead of which it is evident, that as much blood as to a 20,000th part must have passed out of the head as was effused.

Or, if a part of the brain be inflamed, and its vessels enlarged, the branches of the vessels in the rest of the brain must be pressed into a smaller bulk, and must send out of the head, by the veins, as much blood as had been added to the inflamed part.

If the inflammation has been of long duration, the branches of the arteries may be gradually enlarged by the increase of their own activity, whilst the similar increased activity of the absorbent vessels of the inflamed part, may occasion a wasting of the solid matter of that part of the brain, and thereby lessen the resistance to the enlargement of the arteries.

In old persons, especially in such as are addicted to intemperance, the solid substance of the brain is, like that of the solid parts of all the other organs, gradually wasted to a certain degree, and the bloodvessels of the brain may of course be gradually dilated. Their coats likewise will be gradually made thinner by the same cause, or increase of absorption.

Hence the cause, why old men are more exposed to a rupture of the bloodvessels than young persons, and why there may be an observable dilatation of the vessels.

It may be also observed, that, as the solid matter of the brain is not elastic like compressed sponge, the general size of the bloodvessels of the brain cannot be diminished.

And hence the vessels of the brain cannot be suddenly dilated or contracted, like those of the external soft organs. Although an increased impulse of the blood in the arteries may quicken the motion of the blood within the head, it cannot add sensibly to the quantity of it ; and, on the other hand, that opening the corresponding veins, cannot diminish sensibly the quantity of it.

To make this more evident, suppose a glass sphere, filled with water, to represent the brain, with one tube entering it, representing the carotid artery, and another tube coming out of it, representing the internal jugular vein, upon stopping the artery with my finger, none of the water runs out by the vein, although the end of it is open.*

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* There are some accidents and some diseases incident to men, which bear with all the force of direct experiments upon the question of repletion and congestion of blood within the skull.

One of these is the case of sudden death occasioned by drowning or hanging, in which the function of respiration is very speedily arrested, Hence, as long as the skull is entire, venesection or arteriotomy cannot diminish the quantity of the blood, but nevertheless they prove salutary not only by lessening the force of the heart and arteries, and thereby lessening the danger of their rupture, but also by diminishing the pressure upon the solid substance of the brain; and the less the brain is capable of being lessened in its bulk by compression, the more it will suffer from pressure as the effect of this will be less eluded.

Though the quantity of blood cannot be in a short time changed, yet the proportion of it in different parts of the brain may be altered, as has been proved by Dr Kellie.

Before the bregma of a child has been ossified, or after a surgeon has removed a portion of the skull of an adult by the trepan, the size of the arteries may be enlarged suddenly by an increased action of the heart or carotid arteries, or by interrupting the free return of the venous blood; or their size may in both cases be diminished by arteriotomy or venesection.

My father has given in this treatise a full description of the discovery of the communication between the lateral ventricles of the brain, which becomes very apparent on account of its increased size, when a large quantity of water has been accumulated within the lateral ventricles of the brain.

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the lungs and right side of the heart immediately are loaded with blood, and the blood no longer returns to the heart by the veins; and, in the case of death by hanging, the carotid arteries and jugular veins are compressed by the rope, while the vertebral arteries, being unobstructed, probably continue to transmit blood to the brain as long as the action of the heart continues.

For a few minutes after the victim has been suspended, the blood flows to the brain by the vertebral arteries, but its return is, in a great measure, interrupted by the pressure made upon the jugular veins, and the cessation of respiration. Hence, it was supposed, that death, in cases of suspension, was produced by congestion of blood within the head, or apoplexy. But an examination of the brain of different criminals killed by suspension leads me to dissent from such an opinion as to the cause of death, which is the effect of the suspension of respiration.

Dr Monro read to the Philosophical Society of Edinburgh in 1764, a paper on the communication of the ventricles with each other, and on their supposed communication with the medulla spinalis, with some remarks on the hydrocephalus and spina bifida, and on tapping in these diseases, illustrated with figures. In my book on the Morbid Anatomy of the Brain, there is a detailed account of the different species of hydrocephalus: the first, the most acute, proves fatal in two or three days; the second, in five or six weeks; and the third, the acute is converted into the chronic form of the disease by the disjunction of the bones of the skull at the sutures, after they have been consolidated; and lastly, there is a congenite form of hydrocephalus, a disease of the fœtus in utero, which is a disease, of several years' duration,* which last form of the disease according to Dr Conquest, is sometimes cured by puncturing the brain. "I have now tapped in *nineteen* cases, and of these *ten* were living when last heard of. In some cases the results have been triumphantly successful; in others, from the reluctance of the parents to have the operation repeated, only temporary relief has been afforded; but none of the children died either during or immediately after the operation."

My father denied the identity between electricity and the nervous influence.

"From the experiments of my father, it is proved, that, whilst the electrical fluid is passing from the toes, upwards along the muscles, it does not throw them into convulsions, but that it does so, as soon as it begins to pass along the trunk alone, of the nerve. At that instant, therefore, *the electrical fluid is moving in the direction upwards, and the nervous energy is moving downwards, from the trunk of the nerve into the muscle:* or in the trunk of the nerve, the electrical and the nervous energy are moving and acting in contrary directions. Hence we are led to infer, that THE NERVOUS ENERGY IS DIFFERENT FROM THE ELECTRICAL, AND THAT THE NERVE IS MERELY STIMULATED BY THE ELECTRICAL FLUID."

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* *Vide* Plate 2d, which represents an expansion of the lateral ventricle of the brain.

To this opinion MULLER* has subscribed, and has added, the electric fishes have been stated by some as evidence of the identity of the nervous influence and electricity, but in these fishes the electric organs resemble a galvanic pile; if electricity and the nervous influence were the same, *no such apparatus would be required, but merely conductors.*

Dr WILSON PHILIP is a strenuous advocate for the great influence of the nerves on secretion. He observes, " It appears, then, that by means of the system of ganglionic nerves, the influence of every part of the brain and spinal marrow is bestowed on secreting surfaces, and on those organs by which the supply of their fluids is regulated, and that this influence is necessary to their functions. But it is not the secreting power alone that is thus placed under the influence of every part of the brain and spinal marrow; for it is a necessary inference from experiments, that the whole of those processes on which the healthy structure of the part depends, are under the same influence.

" The influence therefore of the whole brain and spinal marrow is thus united by nerves from various parts of these organs entering ganglions and plexuses."

But though the influence of the nerves upon glands or rather upon the bloodvessels proper to glands, be very considerable, it is not unlimited.

Thus in cases of apoplexy, though sensation and voluntary motion be suspended, yet secretion is not so.

In cases of hemiplegia, the secretions of the paralytic side of the body are continued; and though the urinary bladder be paralytic, the mucus continues to be secreted by the mucous glands; and also the mucus of the throat in cases of palsy.

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* *Vide* his Physiology translated by BALY.

Nervous sympathy, a subject which has engaged the attention of my father and of several eminent physiologists, well merits full consideration.

Considerable attention has of late years been paid by physiologists to the ascertainment of the cause of the sympathetic connections between the different parts of the body. Since the time of Willis and Vieussens, physiologists appear to have been satisfied that this was to be sought in the nervous system; but these two celebrated individuals, and their immediate successors, supposed that it was dependent upon the anastomoses of the different nerves in their course. Dr Monro secundus (Observations on the Structure and Functions of the Nervous System, p. 99, Edinburgh, 1783), and Dr Whytt (on the Sympathies and Diseases of the Nerves, Edinburgh, 1765),* adduced conclusive arguments to prove that this explanation was totally insufficient to explain the various sympathetic actions of the body; and that they required for their manifestation the presence of the central organs of the nervous system,—the brain and spinal marrow. From the time of Redie it had been ascertained that an animal, when deprived of its brain, would continue to manifest various sympathetic movements, such as the respiratory, the withdrawal of the limbs, when the skin is injured, &c.; and Dr Whytt made a very important advance in our knowledge on this subject, by proving experimentally that all the sympathetic movements observed in a decapitated animal ceased, on destroying the spinal cord. Dr Monro maintained, that the mind could not be considered as the sole, or even the chief agent in the production of the sympathetic actions, unless we adopt the unphilosophical opinion that it is engaged in operations of which it is not conscious; and he was farther in favour of the opinion, that sensation is seated in the encephalon. Though Dr WHYTT insisted strongly on the fact, that sensation was intimately linked with many of these sympathetic movements, yet there are various passages in his works which would seem to shew that he was of opinion, that sensation was not necessarily connected with their manifestation. It must also be remembered, in contrasting the opinions of Drs WHYTT and MONRO on this subject with those of modern physiologists, that they sometimes apply the term sensation to some conditions of the body, of which we are not conscious, and that, in these cases, they use it to imply what is now expressed by *excitability*. The experiments of LE GALLOIS, FLEURENS, and the observations of LAWRENCE, LALLEMAND, and OLIVIER upon anencephalous fœtuses in the human species, have still farther illustrated and confirmed the fact, that all those sympathetic muscular movements engaged in sucking, swallowing, breathing, defecation, and urination, are not dependent upon any part of the encephalon above the medulla oblongata. PROCHASKA, Sir G. BLANE, and FLEURENS, have also maintained, that these muscular movements are not dependent upon consciousness. Incorporating these views with the discoveries of Sir C. BELL, we would conclude, that those impressions made upon any of the surfaces of the body, which excite sympathetic muscular movements, are conveyed to the spinal cord by the posterior roots of the spinal nerves, and that the motive influence transmitted outwards to the muscles moved, is conveyed along the anterior roots of the spinal nerves. Dr M. HALL and Professor MÜLLER have well illustrated and extended this view of the subject, as applied to those sympathetic movements observed in decapitated animals, and have especially dwelt upon the fact, that they always require certain excitants for their production. Dr MARSHALL HALL has further maintained, that the intervention of a sensation is not necessary for their performance, and has termed them the *excito-motory* movements. He believes that the filaments of the spinal nerves engaged in their production are distinct from those engaged in conveying those impressions which excite sensation, and also from those which convey outwards the motive influence of the mental act of volition to the muscles. Those filaments which convey the impressions inwards to the spinal cord, by which the sympathetic movements are excited, are, according to Dr Hall, bound up in the posterior roots of the spinal nerves, along with those filaments which convey inwards the impressions which excite sensation, and these he terms the *incident* nerves. The filaments which convey the motive influence outwards from the spinal cord, by which the muscles are excited to these sympathetic movements, are in the same manner bound up in the anterior roots of the spinal nerves with the filaments which convey the influence of volition, and these he has termed the *motory* nerves. He believes that these *excito-motory* filaments terminate in the spinal cord, while those engaged in the production of sensation and volition are, on the other hand, continued upwards to the brain, as it is in this organ alone that these functions are manifested. Mr Grainger has more lately maintained, that these supposed excito-motory filaments of Dr M. Hall are attached to the grey matter of the spinal cord, and terminate there: while the filaments connected with excitation of sensation and the voluntary movements are connected with the white fibres of the cord, and are prolonged upwards to the brain. Though it is quite possible that there may be nervous filaments engaged in the production of the sympathetic muscular movements, distinct from those which convey inwards the impressions which excite sensation, and transmit outwards the motive influence of volition, yet no decisive evidence of this has yet been adduced.*

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* Dr Monro, eight years previous to the publication of Dr Whytt's work, maintained, in his lectures, the same doctrines. *Vide* Observations on the Structure, &c. of the Nervous System, p. 100.

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* I am indebted to Dr J. Reid for the above observations on Sympathy.

I beg to refer the reader to a summary of the varied discoveries which have been made within these few years regarding the functions of the nerves given by Muller. As much light has been thrown upon this important department of physiology by Sir C. Bell,* Muller,† Valentin,‡ and Dr Alison,§ based upon the very brilliant discoveries of Sir C. Bell, I therefore add the following outline of these, which was written at my request by Sir Charles himself.

"Dr Monro's work on the Nervous System, was the foundation of all that has been done by Sir Charles Bell.

"This he acknowledged at the meeting of the British Association held here in 1834. When laying the volume before the Association, he pointed out the particular engravings, which he said he contemplated long previous to making those dissections and experiments which led to such singular results. If the reader will cast his eye on the folio volume on the Nervous System, he will see how the subjects presented there give proof of this assertion. In plate X., the anatomy of the spinal nerves is set forth, and their double origin distinctly marked. In plate XIX., there is a more remarkable coincidence; two nerves, branches of the fifth nerve, and branches of the seventh nerve of the brain, uniting in their course, go to the same muscle of the cheek. And there is even a third plate, which must have proved interesting to that gentleman, a view of the fifth nerve."

All who are acquainted with Sir Charles Bell's discoveries, must acknowledge that these are the very points of the anatomy on which his opinions are grounded, and which might have given rise, and which, we believe, did give rise, to those experiments which were so successful in displaying the system of the nerves.

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* *Vide* his different works on the Nervous System.

† *Vide* his Physiology, translated by *Baly*. London. 1838.

‡ Valentin, Berne, 1839.

§ Physiology, 2d edition. Edinb. 1839.

‖ *Vide* Nervous System, Plate X, and Plate II. of this book.

The observations of Sir Charles are thus directly connected with Dr Monro's labours.

Sir Charles Bell has said that, in displaying the second or optic nerve, the third or motor, the fourth or trochlearis, the ophthalmic branch of the fifth nerve, all crowding into the orbit, the natural question was, Can they be all for the same purpose?

Again, in demonstrating the three nerves which go into the tongue, his reflection, we must acknowledge, was a very natural one; If nerves are all alike, why is there this concourse of distinct nerves to the same organ? On this idea he proceeded, first by dissection, then by experiment, to discover, if nerves called common nerves, were composed of distinct roots, and if these roots had distinct functions. He tells us that his first experiments were upon the brain, and these failing, he thought of the spinal marrow, as admitting of experiments, probably decisive of the question. With this view, he opened the spinal canal of an animal rendered insensible, but still retaining irritability of muscles. Carefully separating the roots of the spinal nerves, he made experiments on them. On irritating the posterior root, he found no result; but on drawing a needle across the anterior roots, the muscles of the back were put in action, and, as he said in our Royal Society, the motions of the muscles were as distinct, as when a boy pressing the keys of his sister's piano makes the hammers dance within.

Sir Charles thus arrived at a proof of the correctness of his notion, that different filaments were bound up in the same nerve, and that the function of these filaments differed according to the columns from which they arose.

Returning to the original ground of his inquiry, why many nerves congregated to one organ, as the eye, or the tongue, and thinking, as he has said, of Plate XIX., in which Dr Monro presents the two nerves going to one muscle, he determined to ascertain whether these nerves performed the same function. He accordingly performed the experiments on a rabbit, an ass, and a horse, by which the very curious and important fact was discovered,—that, by dividing the branches of the portio dura, the nostril and lips were deprived of motion, whilst they retained sensibility, —that, by dividing the branch of the fifth nerve, they were deprived of sensibility, but retained motion.

Experiments were then instituted to shew, whilst the fifth nerve was the nerve of sensation to the head and face,—that it was more;—for having two roots, and in this respect resembling the spinal nerves, it was a nerve of motion as well as of sensation.

As, however, it supplies only the muscles which move the jaw, he called it the manducatory nerve, whilst the portio dura of the seventh nerve influenced the features in communication or sympathy with the act of breathing. He called this the respiratory nerve of the face, and shewed it to be active in articulation, and in expression.

As Sir Charles has said—the great principle being discovered, further improvement was to be obtained by anatomical investigation simply.

And now, looking to the spinal marrow, it appears that there are two distinct classes of nerves; first, those in regular succession from one extremity of the spinal marrow to the other, coming off in double roots from distinct columns;* and another series of nerves with single roots, and neither strictly belonging to the anterior or posterior column. These are the spinal accessory nerve—the nervus vagus—the glosso-pharyngeal nerve—and the portio dura of the seventh; to which he added, on more obscure grounds in the anatomy, the diaphragmatic nerve. These nerves all diverging from the lateral and upper part of the spinal marrow, and sent to the different parts of the animal frame, cross the others, and produce much of the seeming intricacy of the Nervous System.

The former class of nerves was remarkable for their regularity; these, for their apparent irregularity.

They constitute the respiratory nerves of Sir Charles

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* *Vide* Monro's Nervous System, Plate X. Edinburgh, 1783.

Bell's system. They combine the parts in the act of respiration ;—as the muscles of the chest, the diaphragm, and the muscles of the throat and larynx. It is through these nerves that those remote parts act in unison.

The nerves of the spine which arise by double roots, together with the fifth of the head, he called the regular nerves ; the others, diverging from the centre to the organs and muscles of respiration, he called the irregular or respiratory nerves.

The truth and simplicity of this arrangement have been attested by very many pathological facts.

A disease seated in the root of the fifth nerve of the brain, was found to deprive the side of the head and face of sensation, and the muscles of the jaw of motion. On the other hand, the accidental division of the portio dura of the seventh, was found to deprive the side of the face of all motion and expression. In cases of the spine, it is very commonly observed that motion is lost before sensation, and to a much greater degree. We now see the reason ; and that the anterior roots of the nerves of the spinal marrow are more directly exposed to the influence of the diseased bodies of the vertebræ. A more conclusive proof was given by a tumour forming on the anterior roots of the nerves going off from the *Cauda equina*, and which deprived the patient of the motion of his lower extremities, whilst the sensibility remained entire.

We are now called to observe the difference in the affections of the two classes of nerves. We see that the nerves controlling respiration and expression are more frequently spasmodically affected,—for example, in *clonic spasm*, and *risus sardonicus*.

Also the affection of the sterno-cleido-mastoideus, so very frequent, is attributable to the influence of a nerve of this class. Contrasted with these milder chronic affections, are the affections of the regular nerves producing formidable tetanus. But to do justice to this subject would require a course of lectures, rather than a notice like the present. And we have attempted to give this imperfect sketch, as shewing the importance of those points of the anatomy of the nervous system, which Dr Monro dwelt upon as some thought too impressively.

I have also added the results of the experiments of Dr John Reid, which have been recently published.

Conclusions deduced by Dr J. Reid from his Experiments on the Eighth Pair of Nerves.

1. That the Glosso-pharyngeal Nerve is a nerve of common sensation, and is also one of the principal nerves which transmit to the medulla oblongata those impressions made upon the fauces and pharynx, which excite the muscular movements of deglutition; and that it may probably participate with the fifth pair in the performance of the function of *taste*, but it certainly is not the special nerve of that sense.

2. The pharyngeal branches of the nervi vagi are entirely, or almost entirely, motor; and move the muscles of the pharynx and soft palate.

3. The superior laryngeal branches of the vagus are almost entirely nerves of sensation and afferent nerves, and the few motor or efferent filaments which they contain are distributed in, and move, the crico-thyroid muscles. The inferior laryngeal are, on the other hand, principally composed of motor filaments, and move all the muscles attached to the arytenoid cartilages.

4. The œsophageal branches of the vagus are partly afferent and partly efferent nerves.

5. Though the movements of the heart may be materially influenced by causes acting through the cardiac branches of the vagi, such as mental emotions and injuries of the central organs of the nervous system, yet these also affect the heart's action through the sympathetic nerves, after the vagi and recurrents are divided in the neck.

6. The pulmonary branches of the vagi are the princi-

pal channels by which those impressions made at the lungs are transmitted to the *medulla oblongata*. When the vagi are cut in the neck, the number of the respiratory muscular movements becomes instantly diminished in frequency, generally to one-half. Dr Reid attributes the death of an animal after section of both vagi, to the congestion of blood in the lungs, arising from this diminished frequency of the respiratory muscular movements.

7. Lesion of the gastric branches of the vagi does not necessarily arrest the muscular movements of the stomach, or the usual secretions poured out upon its inner surface, though each and all of these, but particularly the secretions, may be modified to a very important extent, by causes acting through the nervous system. In four out of seventeen experiments in which the vagi were cut, satisfactory evidences of digestion were obtained. In three of these animals, the vagi were also cut, and a portion removed.*

It may be added, that Dr J. Reid presented to the Museum of the University the results of some of his experiments on dogs, in which he had divided the eighth pair; and in these, I remarked that the lacteal vessels were as much distended by chyle, as when the eighth pair of nerves had not been divided.

In my Elements of Anatomy, I made mention of cases, in which different nerves had been compressed by tumours, and gave it as my opinion, that the peculiar symptoms in these cases were referable to the pressure made upon the nerves, and to the subsequent disorganization of the nerve. Since that period, I have prosecuted the same inquiry, and have been led to examine the condition of the par vagum in different aneurisms, which examination has tended to confirm the opinion I had previously entertained.

In several preparations of aneurism, the nerves have been dissected with great care; in some cases, they are flattened, compressed, and forced out of their situation, and in others enlarged and converted into a substance like membrane, apparently from a thickening of their neurilema: the nerves shewn to have suffered in this manner are the par vagum and its different branches; the bronchial nerves frequently also suffer. Now, when we know that pressure upon the trunk of a nerve suspends, or greatly alters, its functions, we should expect some striking phenomena referable to nervous agency to present themselves; and such I apprehend are witnessed, but they have not been sufficiently attributed to their proper source.

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* *Vide* Edinburgh Medical and Surgical Journal for 1838–9.

Physiology teaches us, that when the pneumogastric nerve is cut, great difficulty of breathing ensues, with croupy cough and accumulation of mucus in the lungs; and should we not attribute a lesser degree of these symptoms in aneurism to an inferior degree of injury done to the nervous trunks? We have no hesitation in attributing the dreadful cramps of the inferior extremities, and the involuntary passing of stools and urine, to the effects of pressure upon the lumbar nerves in the case of aneurism of the abdominal aorta; and in the case of aneurism of the thoracic aorta, when so many much more important nerves are liable to be interfered with, it appears to me that, upon the same principles, we may account for the difficult breathing, croupy cough, and loss of voice.

It is not uncommon for aneurism of the thoracic aorta to prove fatal by bursting into the windpipe. I have seen such an occurrence put an end to the life of a patient, in whom, the day before, it was proposed to open the windpipe.

It seems to me extremely probable, that the symptoms of angina pectoris, which are often combined with an ossification of the coats of the arteries of the heart, are in part to be imputed to the pressure of the enlarged and ossified coats of the coronary arteries of the heart, upon the nerves which accompany them.

Dr Monro, in the year 1788, published his Description of all the Bursæ Mucosæ, and instituted a comparison between the bursal capsular ligaments of the joints, and of those short sacs which line the cavities of the thorax and abdomen.

Though the title of this book, when published, was correct, *it is not so now*, as several smaller bursæ have been discovered by Rosenmuller, Schreger, Bichat, Beclard, and others, in the trunk, head, and neck. A German translation of this book has been published, to which many important additions have been made, relative to the anatomy and pathology of the bursæ.

There is a singular observation made regarding the synovia by Kochius, viz. that it is different in different animals, in colour, thickness, and its degree of lubricity; being more liquid in the lesser bursæ.

The comparison drawn between the structure and organic diseases of the different serous membranes of the bursæ, thorax, and abdomen, is highly important. In proof of the identity of the diseases of serous membranes, and of their causes, he particularly observes, that we generally discover an effusion into the cavity of the joints, as well as into the bursæ. On this book and the treatise of Dr Carmichael Smyth* and Mr J. Hunter, the modern system of general anatomy is based.

The bursæ become sometimes enlarged from gout, rheumatism, scrofula, contusions, and dislocation. The round bursæ are more liable to suffer than the vaginal: And such tumours are circumscribed, are not moveable, and may be easily distinguished from abscesses, which are more superficial, and communicate a distinct fluctuation.

My Father's book upon the Bursæ Mucosæ has been very much lauded by the most competent judges, and more especially by a pupil of its author, the celebrated Soem-

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* *Vide* Essay on the different kinds of Inflammation. Medical Communications, vol. ii. London, 1790.

MERING; and it is said, in the Cyclopedia of Anatomy, vol. i. p. 466, "MONRO, who first properly explained their anatomy and uses, in his excellent monograph upon this subject, has made us acquainted with no less than seventy pairs, all situated in the extremities; and, since his day, the number has been further increased by the discoveries of BECLARD and others; so that anatomists are now acquainted with upwards of one hundred pairs, many of them situated in the head and trunk."

The nature of those small cartilaginous bodies, which are occasionally found within the bursæ and other short sacs formed by serous membranes, is also described; and also, that those bursæ and serous membranes which, in the sound state, possess little sensibility, acquire, in consequence of inflammation, a great degree of sensibility, and prove a cause of exquisite pain; and lastly, it has been shewn, that the making an opening into the bursæ mucosæ, with a view of extracting cartilaginous bodies growing from them, is attended with the same bad consequences as the exposure of the internal surface of the knee-joint, unless the operation be performed with the greatest caution.

It may be added, that mention is not made by any author of a bursa of considerable size, which is interposed between the os hyoides and thyroid cartilage. This bursa sometimes becomes enlarged from exposure to cold. It attained about the size of a filbert nut, during two successive springs, in the same individual, a man of thirty-three years of age, and created considerable uneasiness in the throat and difficulty in swallowing, by preventing the hyoid bone from slipping upon the thyroid cartilage. I have been informed by my assistant Mr MACKENZIE, that this bursa is larger in the male than in the female, and that it, in some cases, attains a large size in phthisical patients.

My Father, whilst a student, devoted much attention to the structure of the TESTICLE* and other glands. He proved that the testicle is composed of a number of tubes, which are nearly of the same size, much convoluted, and of great length; that these tubes form a net-work, from which, twelve or fourteen straight tubes lead to the epididymis, which he discovered to consist of a single tube, so that the course of the semen may be interrupted by puncturing one of the tubes, and that sometimes there is a small tube issuing out from the epididymis two or three inches in length, which has a shut end.

He afterwards extended his observations, and published them as his inaugural dissertation. Dr Monro's Thesis, Edinburgh, 1755, on the Anatomy of the Testicle, has been held in high estimation, and been much quoted.

Since it was published, a few additions have been made to our knowledge of the structure of these glands by Sir A. Cooper, Lauth, Krause, and others.

The testes have several coats; the outermost is formed by the fascia spermatica, within which the fibres of the cremaster muscle are fixed.

The second coat, called Vaginal, or Tunica vaginalis scroti, forms the bag of the cavity of the tunica vaginalis, and consists of two layers of unequal thickness: the inner, or true serous layer, is very thin. The third is the serous coat which covered the testicle, whilst it lay in the abdomen, and is named Tunica vaginalis testis. It adheres intimately to the coat beneath, a strong fibrous membrane, which is of a white colour, hence called Albuginea, which last gives a partial covering, including the two anterior thirds of the testis.

The fourth coat is very thin and vascular, and resembles the pia mater of the brain; its chief use is to support and lodge the tubes of the testicle.

A process of the albuginea divides the testicle from the anterior to the posterior surface: this serves to support and connect the seminal tubes, and forms beds for the arteries, veins, absorbents, and nerves. The lobules of the testicle are separated from each other by processes, or septa, derived from the tunica albuginea. According to Krause, there are 484 lobules in each testicle.

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[*] *Vide* Edinburgh Physical and Literary Essays, vol. i.

My Father has described fully the tubes. Lauth has made particular mention of their division and reunion, and adds, that in a small portion which he spread out, and in which there were 49 inches of tube, there were 15 anastomoses.

Dr Monro not only devoted much attention to the structure of the testes, but also to that of the mamma, salivary glands, liver, pancreas, and kidneys. The annexed Plate III. represents the structure of the female mamma, which is composed of an infinite number of small tubes. Sir A. Cooper has very lately published some very beautiful representations of the mamma.

The breast consists of straight tubes in the nipple—of the same tubes expanded at the base of the nipple, and under the areola, which are reservoirs of milk,—of the arborescent or mammary ducts, and of small glands, which are united by a fibrous tissue, and constitute the principal part of the mamma,—and of milk cells, into which the milk is secreted by the mammary arteries. These mammary tubes are lined by a mucous membrane. Sir A. Cooper has also described the evolution of the breast and mammæ of the male, and has given a description of the mammæ of the cow, ass, ewe, hare, rabbit, guinea-pig, cat, bitch, sow, &c. I have seldom seen above eight or ten lactiferous tubes, which do not communicate with each other, as may be seen in plate 7th of Sir A. Cooper's very valuable book on the Anatomy of the Breast, in which they are represented as injected by wax of different colours.

My Father examined with great care the minute structure of the kidneys, after having thrown a penetrating injection into the arteries of the kidneys, and was, I believe, the first person who proved that the acini of the kidneys which are visible to the naked eye, are not, as Dr Nichols called them, *globuli arteriarum termini*, or, as Schumlansky has lately stated, the sources from which the urine is derived.

These acini are proper only to the arteries, and can be injected from these only. Ramifications of the arteries extend beyond these acini,—which account of the minute structure has been lately confirmed by HUSCHKE and MÜLLER of Berlin.

The small branches of the arteries run in straight lines between the uriniferous tubes towards the papillæ of the kidney, and surround the openings of the uriniferous tubes.

According to KRAUSE, the uriniferous canals anastomose with each other, and end in free cæcal extremities. In order to inject the canals in the cortical part of the kidney, expose the surface of the organ in the vacuum of an air-pump; thus by the pressure of the atmosphere the injection flows through the ureter into the uriniferous tubes near to the surface of the kidney.* The urinary tubes are enveloped by capillary bloodvessels, which occupy their interstices. It seems probable that the blood permeates the coats of the uriniferous canals, and undergoes a chemical change in its transit.

Dr MONRO devoted his attention to the LACHRYMAL GLAND, which consists of an upper and lower part, which latter was discovered by Dr MONRO, and also the ducts of this gland, which run nearly parallel with each other, and opening on the inner side of the upper eyelid, not far from the external canthus of the eye. Of this discovery he published an account in 1758, illustrated by engravings. In the turtle I have remarked, that the lachrymal gland is of great size, and there is but one duct leading from it, which is capable of admitting a surgeon's probe. MÜLLER has described cells in this gland in the horse and in birds, which cells may be filled from the efferent duct.

In short, glands are composed of a series of small convoluted ducts, of great length and tenuity, so as to form a very large secreting surface, upon which the ramifications of bloodvessels are distributed, but do not form continuous canals with the excretory ducts of the glands. Nerves may be traced into the secretory part of the mamma, and they accompany the ramifications of the arteries, which are derived from the external thoracic and internal mammary arteries.

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* Such was the mode pursued by MÜLLER.

My Father also directed his attention to the structure of the GRAVID UTERUS,* and to the structure of the PLACENTA, and mode of connection between the mother and child. Dr THOMSON, in volume 1st of his Life of Dr CULLEN, has published a letter which that distinguished physician wrote to Dr WILLIAM HUNTER, in which he observes: "Dr MONRO produced to the Society a preparation of a gravid uterus, and a drawing from it. The purpose of both was to determine the nature of the communication between the uterus and placenta. He says that, when he heard you upon that subject, you were of opinion that certain arteries of the uterus pass the external surface of the placenta, and pour out their blood into the cellular substance of it, to be taken up from thence by the proper vessels of the placenta. He says he was then, and has always been, of a different opinion; but, to determine the matter more certainly, he made this preparation. He had injected the vessels of the uterus with coloured wax, the arteries with red, and veins with green, and left those of the placenta without any injection. This injected uterus he cut longitudinally, so as to obtain a section and distinct view, for some length, of the uterus and placenta as applied to each other; and from this view, he thinks, it is evident that no sensible vessels pass from the one to the other. The vessels of the uterus appear to be perfectly well filled, and in the extremities of the veins the coloured matter is found mixed, but not a particle of it in the placenta. Many arteries of the uterus appear upon its inner surface, forming many convolutions there, and swelling out on that inner surface, but still manifestly confined to it, without any appearance of their entering the placenta. He observes, that, as so many arteries reach the inner surface of the uterus, in separating the placenta several of these arteries may be torn, and give some occasion to the opinion you had formed; but that such a preparation as the present is best fitted to determine this fact, and very strongly supports his opinion of it."

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* *Vide* Paper, vol. i. Edin. Phys. Essays.

According to the recent observations of Dr Lee (Phil. Trans. 1832) the whole placenta may be injected from the vessels of the fœtus, so that whatever passes from the vessels of the uterus transudes through the decidua, and thus gets into the minute ramifications of the umbilical vessels.

The experiments of Magendie and Dr Williams,* shew that camphor and oil injected into the blood of the mother may be detected in the blood of the fœtus, but poison injected into the umbilical arteries, though mixed with the blood on its way from the fœtus to the placenta, does not injure the mother. Repeated observations have proved, that the fœtus did not suffer by a hæmorrhage which proved fatal to the mother.

In the lower classes of animals, as the mare and cow, there is no communication between the fœtal and maternal parts of the placenta; and from what I have seen, I am disposed to think that there is no direct communication by blood-vessels between the fœtal and maternal parts of the human placenta; a spongy cellular substance being interposed.

Meckel has described particularly the veins of the placenta as follows: "Vers l'époque de la maturité du fœtus, il est couvert, à sa face externe, d'une couche qui ressemble beaucoup à la membrane caduque, et qui ne s'étend pas seulement d'un lobe à l'autre, mais pénètre même entre eux, et s'unit d'une manière très intime aux vaisseaux du placenta. Ces derniers communiquent avec ceux de la matrice. Entre eux et le placenta se trouvent des veines d'un très gros calibre. On remarque surtout à la circonférence du gâteau placentaire un veine circulaire, dans laquelle s'abouchent plusieurs veines de la membrane caduque."

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* Edinburgh Medical Journal, vol. xxv.

In the third volume of the Edinburgh Physical and Literary Essays, there is a long and elaborate paper by my father on THE EFFECTS *of opium, ardent spirits, and essential oiis, on the nervous system, from which he infers that these* affect animals in two ways; they act on the nerves to which they are primarily applied, so as to bring all the other nerves into sympathy, and also by being ABSORBED, MIXED, AND CONVEYED WITH THE BLOOD; which latter opinion has been adopted by MÜLLER, &c.¶

MÜLLER has observed that the general symptoms of poisoning are principally owing to the action of the blood impregnated with the deleterious substance on the central organs of the nervous system.*

The experiments on poisoning of FONTANA,† Sir B. BRODIE,‡ and WEDEMEYER,§ have distinctly proved, that the rapid action of local poisoning takes place chiefly through the medium of the blood, but not through that of the nerves. The last named authors state, that prussic acid, which proved fatal in a second when put into the eye, produced *no effect when immediately applied to the nerves;* and C. VIGBOURG|| informs us, that he applied a drachm of the concentrated prussic acid to the brain of a horse, laid bare by the trephine, but no symptoms of poisoning succeeded.

In short, the general effects of poisoning depend on the absorption of the substance into the blood. HUMBOLDT and WILSON PHILIP have proved, that laudanum, or an in-

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* *Vide* translated by BALY, p. 629.

† On Poisons.

‡ Phil. Trans. 1811.

Phys. untersuch uber Nervensysten und die Respiration. Hanover 1817.

|| Act. Reg. Med. Hafn. 1821, p. 240.

¶ *Vide* allusion to this paper in a former part of the Memoir.

fusion of tobacco, applied to the heart, in the first place accelerate the action of the heart, and ultimately put an end to its action, in the same manner as the rubbing the eyebrow with the extract of belladonna paralyzes the sphincter muscle of the pupil, and occasions its dilatation, which I have seen of three days' duration. MÜLLER's experiments prove, that the local action of narcotics on nerves, which are laid bare, and insulated by dissection from other parts, remains limited to the point of application.

Dr PERCY has lately published* a very interesting book entitled, *An experimental inquiry concerning the presence of alcohol in the ventricles of the brain.* He also detected that spirit in the urine of a habitual drunkard. The question as to the mode in which alcohol produces its narcotic effects is discussed at some length. Some suppose that poisons prove fatal by their deleterious effects, impressing the extremities of the nerves of the stomach; others maintain, that the narcotic first enters the circulation, and then produces its impression on the extremities of the nerves, distributed on the inner coats of the vessels.

PERCY says, p. 108, "that the narcotic effects of alcohol cannot in all cases be satisfactorily explained, by adopting exclusively either the theory of an impression upon the extremities of the nerves, or that of direct action upon the central organ of the nervous system."

COMPARATIVE ANATOMY was always a favourite branch of study with my Father. Convinced of the importance of this department of anatomy, in elucidating the structure, and the functions of the human frame, he devoted a large share of his attention to it, and made many important discoveries in that branch of the subject, and particularly as to the brain and organs of the senses, the circulation of the blood, and absorption.

He did not immediately publish to the world his discovery of the absorbent vessels in fishes and oviparous quadrupeds, though he mentioned his discoveries in his lectures, and annually shewed to his pupils the preparations he had made.

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* Nottingham, 1839.

To this circumstance, I beg particularly to call the attention of the reader, because the late and justly celebrated Mr Hewson became at this period (1762) my Father's pupil, and published as his own discovery, the discovery of the absorbent vessels in fishes and in oviparous quadrupeds, which compelled my Father to assert his right, by a rejoinder. My Father's large book on the Structure and Physiology of Fishes did not appear until 1785.

In this, he treats more particularly of the circulating system of fishes—of the secretions, of their internal and external organs; of the numerous experiments he made on the absorbent system, especially on those of the brain and organs of the senses, and on the swimming bladder; of the brain and nerves of the ear of Cetacea and Amphibia, and of those of cartilaginous fishes.

Dr P. Camper was so much pleased by the perusal of this book, that he translated it into the German language, and added many notes to it.

Müller has also spoken very favourably of this book, to which he has repeatedly referred.

It would lead to a very long digression to offer comments upon all the different subjects discussed in this book, considering the immense strides which have been made within these few years in this department of anatomy.

I must limit the attention of the reader to a very few topics.

It may be observed, that my Father made his experiments and observations on the lymphatic system, chiefly on the Nantes pinnati of Linnæus, and found, beyond all doubt, that the distribution of the lymphatic system is universal. He discovered numberless *lymphatics in their brain*, *eyes*, *ear*, and *nose*.*

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* *Vide* p. 32.

He has observed, " In a great number of experiments, by injecting penetrating liquors into the arteries and lymphatic veins of fishes, I have found it impossible to make these liquors pass from the arteries into the lymphatics, or from the lymphatics into the arteries, except where there was a laceration or rupture of these vessels ; yet I have repeatedly injected their red veins from their arteries.

" Hence the lymphatic veins do not seem to be the continuation of the lymphatic arteries of fishes : or we are led to suppose that, as they do not assist directly in circulating the blood, they must be of use by absorbing fluids from the surface, and from the different cavities of their bodies.

" From a variety of observations and experiments, we can convince our reason, that the human valvular lymphatic veins are a system of absorbents ; but in this class of animals, I have discovered that it is possible to give a decisive ocular proof of the truth of that doctrine, by observing the effects of injecting fluids from the trunks into the small branches of the lymphatic veins."

He has described more especially the absorbents of the skin of the skate, and states, " I found that not only water, but air, milk, quicksilver, and even oil of turpentine, coloured with the powder of vermilion, were discharged upon the surface of the skin, by a vast number of distinct orifices, placed at regular distances from each other : yet the force with which these liquors were injected was very small, and there was no extravasation into the cellular substance any where under the skin, or in the interstices of the muscles. On the contrary, the preparations of the parts on which these experiments were made, give the most perfect and beautiful view imaginable of the vast number and extreme smallness of the branches of those vessels dispersed upon the skin, muscles, brain, eye, ear, &c. nowhere distinguished by extravasation."

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* Tab. XXI.

Dr Monro makes the following important remark as to respiration.

" Very numerous and large lymphatics are dispersed upon the gills of the skate. To this, when we add that fishes soon die when put into water from which the air has been extracted, and yet that such water is capable of washing off exhaled matter from the gills, and of taking up phlogiston readily,* we are led to the supposition, that the gills or lungs not only discharge hurtful matter, but serve also to take in from the air, which is mixed with the water, *somewhat* necessary for life; the precise nature of which experiments do not yet enable us to specify." Humboldt has proved that fishes absorb azote from the water in which they respire; and Treviranus has concluded from his experiments, that azote is exhaled in the lower animals, and even exceeds the quantity of carbonic acid formed.

" We may, however, observe, that the colour and quantity of the red particles of the blood, and the heat of animals, are connected with the mode of their respiration; and that it is as conceivable that the crassamentum of blood immersed in serum and inclosed in a bladder, or that blood circulating in the lungs of a living animal, may receive or attract subtile matter from the atmosphere, as that it may discharge such into it."

At page 45, the ear of fishes is described at length, and also in one of the Three Treatises my Father afterwards published.

Dr Monro, in his preface to his treatise on the ear, informs us, that, in the year 1756, he had examined with great care the progress of the minuter branches of the Portio mollis, upon which the sense of hearing depends, and that he had demonstrated these nerves ever since in his several courses of lectures, and had published a description and figures of those proper to man, in his book on the

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* See Cavallo on Air, p. 485.

Nervous System, and two years afterwards, in 1785, a description of the same organ of whales, fishes, and amphibia. He further states, that the existence of semicircular canals in whales, and of the existence of the external ear of the skate, had been denied by Dr Camper, and in 1787, by Dr Antonius Scarpa. In a subsequent book, entitled "Three Treatises on the Brain, Eye, and Ear," he has described more fully the ear and the human cochlea with very great minuteness. It consists of a central hollow conical-shaped pillar, called Modiolus, which consists of the modiolus and infundibulum, and is pierced by a number of very small holes, through which the minute filaments of nerves pass to the different turns of the cochlea, and lamina spiralis, which is composed of two very thin plates of bone and of cartilages; it forms the roof of the Scala tympani, and floor of the Scala vestibuli, and ends in the hamular process; it divides the horn of the cochlea into two parts, so that one-half of the cochlea communicates with the vestibule, the other with the tympanum of the ear.

The very minute branches of the Portio mollis are represented in Tab. xxx. of Nervous System, and also in this treatise.

The Portio mollis is divided into two parts, one of which is distributed upon the vestibule the other on the cochlea, each of which is divided into very minute branches, and they form very intricate plexuses on the vestible and cochlea.

According to Dr Monro, the following is a summary of his discoveries on the anatomy of the ear.

"A. In the human body, I have shewn, that the nerves of the vestibule and semicircular canals, as well as those of the cochlea, pass through numerous small holes or cribriform plates of the Os petrosum.*

"B. That all the branches of the Portio mollis which supply the cochlea, pass through innumerable small holes of a thin conical cribriform plate, which forms the modiolus.*

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* See Nervous System, Tab. XXIX.

"C. That minute nerves pass through the axis of the modiolus, to perforate that part of the cribriform plate, which is common to it and to the infundibulum, to supply the infundibulum and that part of the cochlea which it includes.†

"D. That branches of the portio mollis pass along and between the lamellæ of the osseous septa which divide the cochlea into its gyri;‡ or, that all of them are not conducted by the lamina spiralis, as SCARPA has described and delineated.§

"E. That the nerves in their whole course, particularly along the lamina spiralis, join, and again are separated, so as to form a most elegant plexus, in which new combinations of the nerves are formed.||

"F. That the nerves terminate on the inner sides of the osseous gyri, in a demi-pellucid, soft, pulpy membrane, resembling the retina of the eye.¶

"G. That this soft pulpy membrane is not the periosteum of the cochlea: but as different from it as the pleura is from the periosteum of the ribs.

"H. In whales, I have found an Eustachian tube which had not been described by authors. I have shewn that semicircular canals are not wanting, as was affirmed by Dr CAMPER; and, in the porpoise, I observed that the membranous substance, within the gyri of the cochlea, on which the portio mollis is distributed, might be separated from the periosteum of the cochlea still more easily than in Man.**

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* See Nervous System, Tab. XXIX.

† Ibid. Tab. XXXI.

‡ Ibid., Tab. XXXI; and, of this Treatise, Tab. IV.

§ SCARPA, p. 55, and Tab. VIII.

|| See Nervous System, Tab. XXXI.

¶ Ibid., Tab. XXXI; and, of this Treatise, Tab. III.

** See Book on Fishes, Tab. XXXV; and, of this Treatise, Tab. V.

" I. In the tortoise, as an example of the amphibia, I have described the Eustachian tubes, and the connection of the several parts of the ear, more accurately than had been done by former authors.* And it may be worth while to add, that the toad, as well as the frog, is provided with an Eustachian tube; as this is denied by GEOFFROY.†

" K. In some of the pisces of LINNÆUS, I have not only described and painted the connection of the semicircular canals, and of sacs which may be compared to our vestibule, but I have traced, with accuracy, the course and termination of their nerves.‡

" L. In the skate and angel-fish, I have discovered the orifices of the meatus auditorii; shewn the winding of their conchæ aurium; the terminations of their meatus auditorii in the vestibules; the communications of their semicircular canals with each other and with the vestibules; and distribution of their auditory nerves, and of the circulating and lymphatic vessels of their ears.§

" M. Particularly, I proved that the semicircular canals in fishes were much smaller than the osseous or cartilaginous tubes which enclosed them; and that, so far from their being composed of the periosteum or perichondrium of these canals, there was a considerable space between them and the periosteum or perichondrium, filled with fluid, contained in a cellular substance, on which minute nerves, with numerous circulating and absorbing vessels, were dispersed, and conducted to the perichondrium and periosteum.|| I observed farther, that in certain fishes, of the genus Gadus, spheroidal bodies, which I had discovered,

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* See Book on Fishes, Tab. XXXVI.

† GEOFFROY sur l'Organe de l'Ouie, 1778, p. 65—71.

‡ See Book on Fishes, Tab. XXXIX.

§ Ibid., Tab. VII, XXXVII, XXXVIII; and of this Treatise, Tab. VI, VII.

|| See Book on Fishes, Tab. XXXVII, XXXVIII, XXXIX.

making in them part of the nervous system, were dispersed in the cellular substance, between the semicircular canals and the periosteum of the tubes which contain them."*

The same motives which induced me to make no comments upon the disputes between Dr Hunter and my Father have led me to introduce but one observation concerning chapter vii. of my Father's Treatise on the Ear, which contains his remarks on Scarpa's Book on the Ear; viz. that, as far as I know, Scarpa did not reply to these.

Since the publication of my Father on the Ear, several treatises on the ear have been published. Those of Soemmering, Weber, Breschet, Wharton Jones, and Blainville, and the admirable plates of Arnold of Zurich, merit the most particular notice.

My Father described the sac of the vestibule and cartilaginous canals, communicating with it in fishes, which probably paved the way for the discovery by Scarpa of a similar structure in the human body; and these sacs are also filled by a fluid and cretaceous substance.

Since my Father published on the ear, very little has been added to the anatomy of the portio mollis. His assistant Mr Fyfe, in his Comparative Anatomy, vol. ii. p. 443, has observed, that the fibres from the calamus scriptorius and pons varolii, of which the portio mollis is formed, had been observed *particularly strong in a blind man, whose hearing had been very acute.*

The membrane of the vestibule is divided into two sacs, the one called by Breschet the *utricle*, the other the *sacculus*, each of which contains cretaceous substances, which are found in all vertebrated animals, and are harder and larger in aquatic animals. These substances are suspended in the fluid by the very minute branches of the portio mollis.

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* See Book on Fishes, Tab. XXXIX.

The internal ear also receives nerves from a branch of glosso-pharyngeal nerve, which enters the tympanum near to the foramen stylo-mastoideum, is spent on the membrane of the tympanum, and joins with the VIDEAN nerve and filaments of the sympathetic.

This nerve has been traced with great care by my friend and former pupil Mr SWAN.*

ARNOLD has described what he has called the *ottic ganglion*, which is connected with the third part of the fifth pair of nerves, and lies at the inferior and posterior part of the foramen ovale. The tympanine branch of this glosso-pharyngeal pterygoid and sympathetic nerves join it. From this, branches pass to the muscle called tensor tympani. I have examined this part of anatomy with considerable care, and found this ottic ganglion to be very small in some subjects, and awanting in others; sometimes present on one side, but absent in the other. It is more distinct in the sheep than in man, and larger in the long-eared rabbit than in any other animal I have examined.

My Father has described and represented the osseous parts of the ear in the *Cete Physeter macrocephalus* of LINNÆUS, or Spermaceti Whale, and a cartilaginous plug in the external passage. In this animal, the mastoid cells are of great size, and incased in very hard bone. The bones which form the chain are large; but the semicircular canals are very small in proportion to the size of the other parts, and most especially to that of the cochlea, which resembles that of the human body.

My Father has also described a Eustachian tube.

It has been affirmed by Mr BURNET, in his book on the Animal Creation (Lond. 1838), that the Eustachian tube communicates with the air through the blow-hole, the only part above water; and this tube is provided with a valve, which covers its entrance, in order to prevent the admission of water when the animal is in the act of spouting.

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* *Vide* Treatise on the Nerves, p. 271.

Many genera of fishes have no Eustachian tube. Scarpa and Cuvier have supposed that the fifth pair of nerves supplies, in fishes, the place of the auditory nerve, which is a mistake.

Microscopical Observations on the Nerves of Hearing and Smell.—Many investigations of this nature were made by my Father: the pars petrosa of the temporal bone was put into a weak solution of nitric acid,—which renders it soft, and at the same time hardens the nervous fibrils,—in this manner he was enabled to trace the very minute fibrils of the portio mollis distributed upon the vestibule, semicircular canals, and cochlea of the ear.

He also discovered the number of ramifications of the olfactory nerves.*

This subject has lately engaged very much of the attention of the French and German anatomists. Prevost and Dumas, Valentin and Breschet, state, that the nervous fibres terminate, 1*st*, In the muscles,—by regular anastomosing loops between every two fibres; 2*d*, By uniting to form a network, as is described by Schwann, in the mesentery of a frog; or, 3*d*, According to Treviranus, Muller,† and Gottsche, they (the fibres of the nerves of the eye and ear) terminate in an isolated manner, without being connected with each other. This description accords with the representation of the minuter fibres of the olfactory nerves given by my Father in plate xxiv. of the Nervous System, figs. 1, 2, and 5, and also with plate xxxi. of the same book, in the explanation of which plate, the author observes, the " membrane lining the human cochlea, with the nerves from the portio mollis, are represented *with the utmost accuracy*."

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* *Vide* Nervous System, plate XXIV. Mr J. Hunter's Views of the Olfactory Nerves, subsequently published at London, which are of the size of nature, correspond with those of my Father, published in his Book on the Nervous System, in the year 1783. Professor Scarpa subsequently published his Views of the same Nerves.

† *Vide* Physiology, translated by Baly, p. 604.

The reader is referred more especially to fig. 3 of this plate, in which the branches of the portio mollis, distributed on the first turn of the cochlea, are magnified to three diameters; and to fig. 4, in which they are represented magnified to thirty diameters.

Dr Monro has made particular mention of a number of experiments, which he made with the view of determining the rate at which sound travels through water. He did not fully attain his object; but clearly proved, that sound passes more quickly through water* than through air, and further, that the tone of a bell, when rung under water, is altered. The reader is referred to Sir J. Herschel's Essay on Sound in the Encyclopædia Metropolitana, for many important observations on the propagation of sound.†

Sound is transmitted with greater or less rapidity in proportion to the density of the medium through which it passes, which explains the cause of the greater velocity with which sound is propagated by ice than water, and also the greater perfection of this sense of the adult. The bones of the fœtal ear are by no means so hard as those of the adult. The osseous part of the Eustachian tube and external ear is not perfect, and the tympanum of the ear and mastoid cells are not of the same proportional size, all of which circumstances combine in abridging the range of hearing. The tremulous vibrations of the bones of the head increase the intensity of sound, and render the sense of hearing more acute; and hence, when we wish to deaden sound, we press the head with the hands, and hold it firmly.

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* According to Pinel, a paucity of water in the vestibule, cochlea, and semicircular canals, is sometimes a cause of dulness of hearing.

† *Vide* Experiments of Wheatstone on Audition. Journal of Royal Institution for July 1827.

Professor Monjon of Geneva has very ingeniously compared the skull to a harmonic case, which communicates its vibrations to the internal ear; and adduces, in support of his theory, the case of Dr Bennati, and of another celebrated musician, whose skulls were remarkably thin, and where the sutures of the skull had been obliterated.

The extent of the range of hearing is very different in different persons. Dr Wollaston has made the subsequent observations on this subject.

"I have found that an ear which would be considered as perfect with regard to the generality of sounds, may, at the same time, be completely insensible to such as are at one or the other extremity of the scale of musical notes, the hearing or not hearing of which seems to depend wholly on the pitch, or frequency of vibration, constituting the note, and not upon the intensity or loudness of the note. While I was endeavouring to estimate the pitch of certain sharp sounds, I remarked in one of my friends a total insensibility to the sound of a small organ-pipe, which, in respect to acuteness, was far within the limits of my own hearing, as well as of others of our acquaintance. By subsequent examination, we found that his sense of hearing terminated at a note four octaves above the middle E of the pianoforte. This note he seemed to hear rather imperfectly; but he could not hear the F next above it, although the hearing is, in other respects, as perfect, and his perception of musical pitch as correct, as that of any ordinary ears.

The range of human hearing comprised between the lowest notes of the organ and the highest known cry of insects includes more than nine octaves, the whole of which are distinctly perceptible by most ears, although the vibrations of a note at the higher extreme are six or seven hundred-fold more frequent than those which constitute the gravest audible sound.

Comparative anatomy and disease have thrown considerable light upon the use of the different parts of the ear, and have also shewn how far each part contributes to render the sense of hearing more acute. For instance, the external ear, from being composed of very elastic cartilage, over which the skin is very thin, and stretched by small muscles, and, from its position and form, is admirably adapted for receiving, collecting, and reflecting inwards the pulses of sound into the external passage.

The sense of hearing is rendered much more acute by the greater magnitude and mobility of the external ear, of the quadruped, and also by the power these animals possess of directing the ear towards the sounding body. If, therefore, the external ear be imperfect, slit, or cut off, and if the membrane of the passage be thickened, or the external passage obstructed by an accumulation of hardened wax, by extraneous bodies, or by a tumour, dulness of hearing follows, and complete deafness, if the external passage be wanting.

Some difference of opinion has prevailed as to the use of the membrane of the drum, the vibrations* of which have been supposed by some to render the sense of hearing more perfect, an opinion controverted by this sense being retained, though there be a considerable aperture in this membrane ; but if the air cannot reach the cavity of the tympanum from an obstruction of the Eustachian tube, dulness of hearing follows, which may be obviated by perforating the membrane of the drum or mastoid cells, as recommended by Heister, Jasser, and Arneman.

The greater the extent of the tympanum, the more perfect is the sense of hearing. In animals such as the elephant, remarkable for acuteness of hearing, the tympanum is of great size, and communicates with the large cells between the plates of the skull, and with the corresponding parts of the opposite side of the head. A similar communication between the ear may be noted in birds ; so that whilst the animals seem to employ one ear only, they are employing both organs.

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* Savart's observations led him to conclude, that the membrane of the drum vibrates, and that its vibrations correspond in number with those of the sounding body which cause the oscillations of the air.

With regard to the chain of small bones which pass across the cavity of the tympanum, it may be remarked, that the incus and malleus have been frequently discharged, after scarlet fever, without destroying the sense of hearing. According to Cruickshank, the destruction of the stapes of a dog destroyed the sense of hearing.

The vestibule is undoubtedly the most essential part of the organ of hearing. It is common to all the larger animals, and consists of a sac, which contains a cretaceous substance, suspended by nervous filaments* in a gelatinous fluid.† Further, the deficiency, imperfection, or diseases, or the obliteration‡ of this part of the ear, destroy the sense of hearing.

Different opinions have been entertained as to the use of the cochlea. The most modern opinion is, that it receives the vibrations of sound which are propagated through the bones of the head, and that by it we are made sensible of the qualities of sound.

The discharge of pus from the ear, which is often connected with caries of the tympanum, mastoid cells, or cochlea, is a very common cause of loss of hearing and of life. Some patients have recovered, upon the discharge of the diseased bone. Acrel gives a case, in which a piece of bone was detached in the tympanum, which was removed, and the patient recovered.

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* Treviranus has described a papillary termination of the retina and portio mollis, which I have not seen.

† Blainville, Scarpa, and Comparetti, have described these substances in the human ear. They are also found in the ears of other mammalia, in birds, in chondropterygenous fishes with fixed gills, and reptiles. Similar substances, according to Breschet, are found in the cochlea of the ear of the human fœtus.

‡ When a pupil of Mr Cline, I heard him make mention of the case of a young man who had been born deaf and dumb, and who died from fever. The vestibule and cochlea were found filled by a substance like to cheese.

I have had several opportunities of witnessing the effects of this disease, which usually occurs in persons of a scrofulous habit of body, and sometimes proceeds to a great extent, involving the greater part of the temporal bone before extinguishing life. My Father, in his Lectures upon Surgery, used to make the following remarks upon this disease. I quote from his manuscript:—

" Suppuration within the meatus auditorius externus is by no means uncommon in children, especially in such as are of a scrofulous habit; and, as the discharge often continues for a number of years, the bones are apt to be attacked with caries.

" In some cases, the caries spreads into the cavity of the tympanum, and preys upon the plate of bone which is between the cavity of the tympanum and the brain; and, in six different cases in which I have been consulted, the ulceration, extending still farther and corroding the basis of the brain, terminated in convulsions and death.

" I had an opportunity, after death, of examining the heads of three of these persons. In all of them, a considerable quantity of very fetid purulent matter was collected in the bottom of the brain over the ear, and the top of the tympanum had several holes corroded in it.

" In the case of a child, the Os petrosum was so much corroded, that the cochlea was found lying loose among the pus.

" If, therefore, a tedious suppuration of the ear forms, attended with a discharge of fetid matter, such as we observe produced where bones are carious, and is followed by symptoms of the brain being affected, there is great reason to suspect that the plate of bone between the cavity of the tympanum and the brain has been corroded, and that purulent matter is collected at the basis of the brain.

" The cranium about the top of the mastoid process is therefore to be accurately examined; and if any mark of caries is observable, the trepan is, without delay, to be applied a little above it; and although no caries is distinguishable, and this will be generally the case, because the part principally affected lies deeper at the base of the skull, yet if the symptoms of the affection of the brain continue, and especially if they become more evident and violent, the operation of the trepan ought to be hazarded. Let the surgeon, however, guard himself against reflection, by stating the great danger of the case; and that the operation is not to be depended on for a cure, but gives the patient merely a much better chance of recovery than he would have if no operation was performed.

As to the importance of the semicircular canals to the sense of hearing, we are still in the dark. The great size of these passages in the owl and bat, and in animals that hear very acutely, favours the opinion, that they conduce to the acuteness of hearing, and more especially when it is taken into account that congenital deafness, according to Valsalva,* Murer,† and Mr Cock,‡ is connected with an obstruction of these tubes; but these canals are of very small size in the whale and elephant, animals that possess a very acute sense of hearing.

Much difference of opinion prevails as to the seat of the musical ear. It has been said to reside in the cochlea, but until this part of the human ear be proved to be larger in those gifted with a musical ear than in others, destitute of this additional sense, such an opinion seems objectionable; besides the musical ear is independent of the sense of hearing, and the former is sometimes lost though the latter be retained, of which I met with a most striking example;

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* De Aure Humana. † De Causis Cophoseos. Hafniæ, 1825.

‡ Guy's Hospital Reports, No. 7, October 1838. It seems proper to notice, that in some of the cases of congenital deafness, described by the latter author, the fenestra cochleæ was obstructed by bone, and the spiral canals of the cochlea were imperfect.

I possess a specimen, in which there are only two semicircular canals.

and, further, some birds, whose cochlea is very imperfect, as the grey parrot, bullfinch, and canary, may be taught to sing.

Deafness is also sometimes connected with organic diseases of the nerves, or of tumours compressing these, but still more frequently from palsy of the acoustic nerve. In the museum of the University, there is a specimen in which deafness was occasioned by a large tumour, compressing the portio dura and mollis. The muscles supplied by the branches of the portio dura were paralytic,* a portion of the pars petrosa had been absorbed. Dr ALISON has a preparation, in which a clot of blood extravasated near to the pons varolii rendered the patient deaf. The same effect is said by ARNEMAN and MECKEL to happen from atrophy of the portio mollis.

MORGAGNI, PINEL, and other authors, have made mention of the atrophy†, softness, or induration‡, of the portio mollis.

It may not be improper to add, that Sir C. BELL|| and Mr SHAW§ make mention of neuralgia and palsy of the face, with inflammation of the conjunctiva of the eye, as being produced by lesion of the portio dura, independently of disease of the brain. As the sympathetic nerve is connected with the glosso-pharyngeal nerve, dulness of hearing and deafness sometimes originate from diseases of the abdomen.¶

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* MAGENDIE has stated, that the destruction of the fifth pair of nerves destroys sensation of the chorda tympani and its ramifications. This he proved by experiments on a rabbit; but the division of the same nerve of a cat, within the skull, does not, he adds, impair the acuteness of hearing on the same side.

† *Vide* HOFFMAN de difficile auditu.

‡ *Vide* ITARD, tom. ii. p. 406.

|| Exposition of Nervous System, p. 133.

§ Med. Chir. Trans. vol. xii.

¶ *Vide* SARD de Functione Nervi Sympathetici.

Of Deafness from a Paralytic State, or complete Palsy of the Nerves of the Ear.

Where deafness is owing to a paralytic state of the portio mollis of the seventh pair, which is distributed on the cochlea and semicircular canals, besides blistering and other common remedies and applications, we ought to draw the electrical stream and sparks from the ears.* But it appears to me highly dangerous to attempt to pass electrical shocks from the one ear to the other.

Of Deafness and Dumbness.

A great deal of important information on this subject has been communicated in Dr Forbes's Medical Journal, vol. iii., and on the British and Foreign Institutions for the deaf and dumb, in the volumes of the Quarterly Journal and Foreign Medical Review, vol. i. and, considering the number of the deaf and dumb, which in Great Britain was, in the year 1830, said to bear the proportion of 13,650 to 21,000,000, and that the number in all Europe is as 1 in 1537, this inquiry is of the deepest interest.

It affords me much satisfaction to have it in my power, through the kind offices of my colleague Dr Traill, and of Mr Kinniburgh, to add some very valuable information on this head, which was communicated to me in reply to the following Queries, proposed by me to these gentlemen:—

1st, Whether, in your opinion, the deaf and dumb are inferior to other boys and girls of the same age, in their intellectual powers?

2d, Whether you subscribe to the statement of Blackstone who has observed,—a person born deaf, dumb, and blind, is looked upon by the law as in the same state as an idiot, he being supposed incapable of any understanding, as wanting all those senses which furnish the human mind with ideas? If he subsequently become, or in the original, grow deaf, dumb, and blind, not being born so, he is decided to be *non compos mentis?*

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* Majendie applied, with great benefit, electricity. When all other remedies had failed, one of the wires was applied over the chorda tympani. The patient had also lost the sense of taste and power of speech. *Vide* Lancet, vol. ii. p. 526.

3d, Whether congenital deafness be usually connected with malconformation or disease of the ear?

4th, Whether the common opinion, that there are more deaf boys than girls, be correct?

5th, Whether several persons in the same family are often deaf, or whether it sometimes happens that the children of the same family are born alternately deaf?

6th, Is deafness hereditary?

7th, Is deafness frequently curable? Krámer has observed that of 300, 104 were incurable, 188 were completely cured.

8th, Does it often happen that a child born deaf must be also dumb?

Professor Traill's *Reply.*

My Dear Sir,—I shall attempt to answer your questions as far as I can.

1. The deaf and dumb do not appear to me inferior to others of the same age in *intelligence*, though their means of obtaining information are usually more limited. When instructed on the principles of Amman, Sicard, or Braidwood, they are often remarkably intelligent, and are capable of giving *undivided* attention to any study, from their being less distracted by noise than those who hear.

2. The law of England considers those born deaf and blind, and who are dumb, as incapable of managing their own affairs, as the range of their ideas must be exceedingly limited; but a person who is not naturally so, but becomes deaf and blind, would not, I believe, in law be considered as incapable of disposing of his property by writing, or by dictation to a notary, if he retained the power of speech. The

only reason why the state looks on congenital deafness and blindness as indicating deficient intellect, is the want of those senses from which the mind is furnished with most of its ideas of external objects. A person's mind may be stored with such ideas before his accidental blindness or deafness, and thus, aided by the ideas derived from the remaining senses and from *internal reflection*, he would be considered as sufficiently *intellectual* to manage his own affairs, at least as far as disposing of them.

3. I am not aware how far congenital deafness is accompanied by internal malformations of the ear. Externally I could not detect any in many deaf persons I have examined.

4. I have no statistics to shew really in which sex deafness preponderates; but as male births exceed female, there ought to be more males deaf than girls.

5. I have known a deaf brother and sister grow up to be old persons. I have also known one instance of alternate children being deaf, viz. first and third, while second and fourth heard.

6. I know several instances where almost all the members of a large family became very deaf before middle age. In one instance their father had great deficiency in his hearing as he advanced in life, and his children by two different mothers, almost all became very deaf before middle age.

7. I do not know what are the proportions of curable cases. I presume that the two-thirds cured were instances of accidental deafness. Congenital deafness I suppose absolutely incurable in almost every instance.

8. All children born deaf will be dumb, until taught by the plans of Amman or the later teachers. By the way, the history of teaching the dumb to speak is curious. The first who taught this art is undoubtedly a Spanish monk, *Pedro de Ponce*, about 1550. Bonet, a Frenchman naturalized in Spain, about thirty years after his death published a method of doing this, but carefully abstains to

mention his predecessor in the art, and as Pedro left no written account of his methods, Bonet coolly assumes the discovery as his own, though the Spanish historians have preserved the fame of Pedro. The Dutchman Amman, in a little work, (which I have,) published in 1692, gives an account of a method which he used to instruct the daughter of a rich burgomaster, in which he seems to have been very successful. He takes not the slightest notice of either of his Spanish predecessors, and as a just punishment, Amman's name is studiously avoided by our French neighbours, who ascribe the glory of the invention to the Abbé L'Epe'e, who died in 1790. Yet I find Amman's method perfectly identical with that of L'Epe'e and Sicard, viz. baring the throat of the master and pupil, and making the latter *see* and *feel* the play of the muscles about the larnyx in enunciating sounds.

Answers, by Mr R. Kinniburgh, *to Queries regarding the Deaf and Dumb.*

Query 1. Deafness does not necessarily imply a deficiency of any of the intellectual faculties. The deaf have minds capable of attention, reflection, judgment, and memory, as well as others. Let them but enjoy the advantages of education which the hearing possess, and they would display no inferiority.

Had Blackstone lived at the present time, he would have said that the law should be altered, which decides on a person being *non compos mentis* in consequence of becoming deaf, dumb, and blind. I know a female in these circumstances. She received education while deaf, and ten years after she had left school, she became blind from cataract. After she was blind she was taught to read the Scriptures, by the sense of touch on raised letters; and I have frequently conversed with her by touching her fingers according to different positions of the letters of the deaf and dumb alphabet, she answering by spelling on her fingers, as do the deaf and dumb. But a person born *deaf* and *blind*, would be placed in very different circumstances, as there is no channel of communication yet fully discovered to such a mind. Fortunately there are but few known to be placed in such a deplorable condition. I have only seen one case of this kind, viz. Mitchell of Nairn, and he has shewn, that he is not without mind.

Query 2. Nearly two-thirds of my pupils have been born deaf. However, some think that about one-half of the deaf have lost their hearing after birth, during childhood. Deafness in such cases has been occasioned by scarlet fever and measles, sometimes by common fevers, and not unfrequently from colds. I have only seen two cases of external malconformation of the ear. With regard to the internal part of the ear of those born deaf, I deem myself unfit to give an opinion. It has been thought by some that the physical geography of a country combined with certain peculiarities in the habits of its population, influence the spread of this disease ; for instance, in the valleys of the Piedmontese Alps, the number of deaf is 1 to 63 of the population, whereas the ratio in Holland and America is 1 to 2000. In most parts of Europe, it is said to be 1 to 1585, but in the Island of Arran it is 1 to 535.

The teacher of the Doncaster school mentions the following striking fact: In a family where there are five children deaf from birth, all the five were born in a damp house, where the persons who had formerly resided had three children, of whom two were deaf.

Query 3. I believe it to be a fact that there are more deaf males than there are deaf females ; from June 1810 to May 1840, 233 boys have been admitted into the Edinburgh Deaf and Dumb Institution, and during the same period only 164 girls.

The Glasgow Institution admitted from July 1814 to May 1835, 95 males and only 86 females.

In the American Asylum at Hartford from 1819 to 1829, 157 males and only 122 females had been received.

The Dublin Institution Report states, that there were

489 applicants, 279 of these were boys, and 210 were girls.

Query 4. It frequently happens that there are several deaf in the same family. I have one pupil who is the *eighth* in the family deaf and dumb.

A late report of the Glasgow Institution states, "of 23 families, in which there are 125 children, 67 are deaf: in one of these families, in which there are 9 children, 8 of them are deaf."

A London report states that of 20 families containing 159 children, there are 90 who are deaf.

With regard to that part of the query, whether it sometimes happens that the children of the same family are born alternately deaf? I may mention the following case, which is the only one of this nature that occurs to me at present. When the mother of one of my pupils was pregnant, a deaf person came to her door asking charity, and frightened her by his signs; however, she soon forgot the circumstance. The child was in due time born. After a certain time she had a second child, and by the time she became pregnant with the third, she had learned that the *first* was *deaf*, the *second* child heard, but the *third* was also deaf.

Query 5. Of all the children I have had under my care, I have only had *one* whose parents were deaf. I have known many cases where one or both of the parents laboured under this defect that their children have all heard perfectly well; so that it does not appear to me that the malady is in general hereditary; although I have found it among the collateral branches of certain families.

Query 6. I have never known a single case of those deaf from birth who have been cured. A few weeks ago I saw two girls who had just returned from London, who had been there to one Turnbull, who professes to cure the deaf. One of them returned as she went, and the other with her ears much injured, but without the least degree of hearing.

Query 7. Dumbness is the necessary consequence of deafness, except in cases which arise from want of intellect. In such cases the hearing is perfect, but from want of ideas and of judgment to direct the organs of speech in the formation of articulate sounds, the person is dumb.

I have met with cases where the palate was either wanting or defective: of course such persons could not speak so as to be understood.

EDINBURGH, 25th *May* 1840.
INSTITUTION FOR THE DEAF AND DUMB.

Mr ITARD has published his treatment of the deaf and dumb, of which there is an extract in the second volume of the London Medical Gazette.

According to ITARD, absolute deafness is very rare. There are among them (deaf and dumb) men who make no use of the sense of hearing, " because it only can be exercised by an effort of attention, which is painful. Now if these individuals be accustomed to methodical exercise of the faculty, which enables the ear by degrees to mark and compare different sounds, the sense is improved just as a weakened function is developed by gentle exercise. This was the idea which first led M. ITARD, more than twenty years ago, to try, on twelve deaf and dumb persons, a series of exercises and experiments, the result of which was to restore, without operation or treatment, six of them to speech and hearing.

" M. ITARD had recourse at first to the most penetrating sounds, to stimulate the sense of hearing: he accomplished this by striking on a large bell, which he had suspended in the room; he diminished every day the intensity of the sound, either by removing the patient farther from the bell, or by striking it less powerfully. When he perceived that the hearing was becoming dull again, he suddenly roused it by one or two very powerful sounds, and passing immediately to weaker, had the satisfaction to find his patients as sensible to them as they had been before. At a later period, in order to keep up the excitability of the organ, M. Itard made the bell vibrate near the patient's ear, and gradually removed it, without rendering the sound more intense. By these means he increased and kept up the susceptibility of perception, till sounds were heard at the distance of 25 feet, which could not be perceived at more than 10 feet when he began. These experiments were performed in a long narrow corridor—the patients were placed in a line, and along the wall was marked the point at which each ceased to hear ; thus forming an exact scale or register of their progress."

On the Eye.

Dr Monro, for a number of years, devoted much of his attention to the anatomy and physiology of the different parts of the eyeball, upon which he supposed he had thrown considerable light.

His earlier remarks were published in his book on Fishes, and were afterwards very much extended in a treatise, devoted exclusively to the anatomy and physiology of the eye, which he published as a distinct work.

The eye-ball varies in form, size, and in the relative proportions of its component parts, in different animals, and in the same animal at different periods of life ; and, being a very delicate organ, is lodged and protected within a bony case, called the *orbit*, the position and form of which is by no means uniform, but admirably adapted for the extension of the sphere of vision. The eyeball is also defended by the eyebrow and eyelids, which are besmeared by a thin mucus derived from the tunica adnata, and by the tears. The eyeball is made up of three different humours, differing in quantity, density, and refracting properties. These humours collect the rays of light upon the retina in the bottom of the eye into a focus, so as to form an inverted picture of the object upon the retina. Fred. Arnold has lately (1840) represented lymphatic vessels, which are very small near to the margin of the cornea, *vide* Table 2. fig. 7, but I doubt very much whether the vessels represented be lymphatics.

Besides the *tunica adnata*, which retains the eyeball in its place, there is a tough fibrous opaque whitish coat called *sclerotic*, in thickness about a line, which is proper to 4-5ths of the posterior part of the eyeball, and it is connected in front with the clear part of the eye called *cornea;* below this coat there is cellular tissue, in which the small ciliary nerves and ciliary bloodvessels passing to the iris are imbedded.

The second coat of the eye called *choroid* is very thin and pliable, and composed chiefly of a great number of bloodvessels united by cellular tissue. It exhibits a brown colour, and on both surfaces there is a dark-coloured pigment excepting in the albino, and to this is superadded in the horse, ox, cat tribe, and other animals, a membrane, which gives the eye of a living animal great lustre in the dark, a membrane of a blue, green, or yellow colour called *tapetum.*

The third coat, called *retina* or expansion of the optic nerve, extending between the optic nerve and crystalline lens, is covered and lined by a serous vascular membrane.

A chapter is dedicated by Dr Monro to a description of this coat.

Much diversity of opinion prevails as to the decussation of the optic nerves. My father observes, " I have found it very difficult, if not impossible, to determine in what proportion of parts the mixture is made, or to trace either of the nerves with certainty from its origin to the termination in the retina." Upon the degree of intermixture of the fibres of the optic nerves, anatomists are not agreed. I have repeatedly investigated this department of anatomy with care, and have observed the decussation not a semi-decussation of the optic nerves of the human eye. And this is also shewn by the effects of disease, causing blindness of the right eye, which occasions the shrinking of the left optic nerve.

It has been said, that the decussation of the corpora pyramidalia accords in mammalia and birds with the partial decussation of the optic nerves, but this is not observed in reptiles and fishes. On this fact, Dr Alison has observed, that decussation of the optic nerves is generally complete, and all the left half of the field of vision is seen only by the right optic lobe (Physiology, p. 307, 2d edit.); but then, the two eyes being incapable of direction to the same objects, the right and left portions of the whole field of vision are probably never made objects of simultaneous attention, and therefore no contrivance is required to secure that these two great divisions of the visible world should appear in their true relation to each other.

My Father has also stated, that "when the optic nerves after entering the eyeball form the retina, their colour is changed from white to cineritious, but no fibres are to be seen in the human retina, even with the microscope."

I dissent, however, from this observation. I was led during the summer of 1836, to examine the eyes of different animals, after they had been kept for some time in spirit of wine, and observed, that, by the application of a camel's hair brush, a pulpy substance may be washed off, upon which being done, the fibres of the retina are rendered quite obvious.

A difference of opinion has prevailed as to the extent of the retina, which led my father to examine into this much disputed point of anatomy, and get figures of it drawn by his assistant Mr Fyfe. He found that the retina is continued on the inner side of the ciliary processes, and corresponds in number of folds of the choroid coat, and terminates on the outer edge of the crystalline lens.

The retina is covered externally from the entrance of the optic nerve to the ciliary processes, by a thin layer which has been imperfectly described by Dr Monro, and compared by him to the pia mater,* and much more perfectly of late by my pupil Dr Jacob of Dublin,* who has published an elaborate account of this membrane, which he says is a single membrane, in which opinion I concur, and also by Mr Dalrymple, who calls it "*a double reflected serous membrane.*"

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* *Vide* Three Treatises.

Internally the retina is lined by a very thin vascular membrane.

On the temporal side of the optic nerve there is an aperture encircled by a yellow disc, which Sœmmering discovered and described,† in 1791, in the eye of a young man who had been drowned. In my Elements of Anatomy I have observed that this is a foramen, whereas Dr Jacob has supposed this appearance to be produced by a deficiency of nervous substance at that part of the retina. This appearance is not observed in any of the mammalia, excepting the Quadrumana. Dr Knox discovered the same appearance in the retina of lizards. The retina is undoubtedly the most important part of the eyeball, and the seat of vision, as is obvious from loss of sight consequent to diseases of that part of the eyeball; and the experiments of Flourens have shewn, that in many of the lower animals the mere sensations of the eye are referable to the corpora quadrigemina. The Cornea forms the clear anterior part of the eyeball, and is composed of three layers of different structure, the tunica adnata, the layers of the proper and elastic cornea, which latter has been described by Demours, Dr W. Sœmmering, Blainville, and my former pupil Dr Jacob of Dublin; and it may be distinctly observed, after macerating the elastic layer of the cornea, it still retains its transparency, whereas the other parts by this process become opaque.

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* Sir Charles Bell in his anatomy observes, "there is no denial of the existence of Monro's external membrane, only that the vessels of the retina did not run on it, but on the surface of the internal membrane." *Vide* also a letter to the same effect, published by Mr T. Buchanan of Hull, in the Hull Packet, dated December 1828.

† *Vide* Com. Soc. Reg. Gottengensis.

In Chapter V, dedicated to the anatomy of the iris, Dr Monro rejects the opinion of Ruysch, Haller, Zinn, and others, who maintain that the vessels of the iris are colourless, and, on the contrary, affirms that they are filled by red blood; he has also described and represented two muscles as being proper to the iris,—a circular muscle around the pupil, for the purpose of contracting it, and a muscle with fibres radiating from the centre to the circumference of the pupil, for dilating it.

Mr Manoir of Geneva, some years ago, published an account of similar muscles, which I have most distinctly seen in the human iris. It merits, however, particular mention, that those muscular fibres, like to the other muscles of the body, are not uniformly of the same size, nor does their size bear a proportion to the size of the animal; as far as I have observed, they are larger in the leopard than in any other quadruped. The iris receives its nerves from the lenticular ganglion, into which branches from the third, fifth, and sympathetic nerves pass. Mr Mayo has informed us, that the iris contracts by irritating the optic nerve within the skull of a bird, or by irritating the third pair, and, according to Magendie, the irritating the fifth and sympathetic nerves produces a similar effect; and, further, that the muscles of the iris are paralysed by the division of those nerves.

The humours of the eyeball are *the aqueous* which fills and distends the fore and clear part of the eyeball, *the crystalline lens*, which is embedded upon the third humour called *Vitreous*, which fills the greater part of the back of the eyeball. These three humours are contained in distinct serous sacs, that of the vitreous, is remarkably thin, notwithstanding which it may be easily shewn by inflation, or by freezing the vitreous humour. A detailed description of this very thin capsule has been given by Dr Monro; it is glued to the retina to its termination, forms like the retina folds at its fore part, and divides into two layers, between which a canal, in figure like to the bowel called Colon, is lodged.

Dr Monro has dedicated a chapter to the description of the structure of the crystalline lens, which, in many animals, and in the fœtus, is soft, reddish, and nearly spherical, but in the meridian of the life it resembles a double convex and transparent lens, the greater convexity looking backwards, and in old age it is somewhat of a yellow colour, and flatter in point of form, and hence it retreats from the pupil.

Leeuwenhoek has described the concentric laminæ of the lens, which he supposed to be disposed regularly; this my Father has remarked in his book on Fishes, Chapter xi, which he could not observe even with the aid of a microscope.*

Sir D. Brewster (Phil. Trans. 1833) has observed, that in fishes, birds, and some reptiles, and a few mammalia, the disposition of the fibres does not correspond with Leeuwenhoek's description. The fibres are united laterally to each other by a series of teeth; those of one fibre being received into hollows between the teeth of those in contact with it.

According to Dr Monro, the refractive power of the lens is much greater than has been commonly supposed. "I discovered, that the spherical nucleus of the crystalline lens of the cod, which, in specific gravity, is to water nearly as 6 to 5, and to common white glass as 3 only to 10, collects the light so much more powerfully than water or glass does, that its focus is not more than one-sixth part of its diameter distant from its surface; whereas the focus of the rays collected by a glass sphere, is at the distance of one-fourth of the diameter of the sphere; and the focus of the rays collected by a sphere of water, is distant from it one-half of its diameter.*

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* Frederick Arnold has represented (*vide* Tab. ii. figs. 17, 18, 19, and 20,) the fibres of the crystalline lens as being differently disposed in the fœtus and adult.

" On performing a similar experiment with the human crystalline lens, I found, that the focus, of parallel rays of light falling on it, is at the distance of three-eighths of an inch from its centre." The lens is of unequal density, owing to its component laminæ increasing in number from its circumference to its centre ; and as the refractive power bears a ratio to the density, it is therefore greatest towards the centre of this organ. Sir David Brewster has remarked, that the variations of density, producing the doubly-refracting structure of the crystalline lens of fishes, are related not to the centre of the lens, but to the diameter, which forms the axis of vision by which the spherical aberrations are corrected.†

Sir D. Brewster, Dr Young, and others, have endeavoured to form an estimate of the refractive power of the crystalline lens ; and, according to the latter philosopher, the refractive power of the centre of the human lens in a living person is to that of water as 18 to 7. He adds, that the water imbibed after death reduces it to the ratio of 21 to 20 ; but that, on account of the unequable density, its effect on the eye is equivalent to a refraction of 14 to 13 for its whole size.

The fibres of the crystalline lens are, in the opinion of some authors, muscular. Dr Monro endeavoured to controvert this opinion, because he states, that, after the crystalline lens has been removed, the eye, assisted by a common lens, possesses the power of adapting itself to objects at different distances : adding, that the fibres of the lens did possess a muscular power. " They could neither change its spherical figure, nor render it more convex, by lessening the diameter or bulk of the sphere."

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* For a more particular account of my experiments, I shall refer to my Book on the Structure and Physiology of Fishes (1785), chap xi.

† *Vide* Phil. Trans. for 1816, p. 317.

There are three septula in the crystalline lens, and I have seen a cataract split in the direction of these.

By far the greater part of the eyeball is filled up by the vitreous humour, which is contained in a very thin serous membrane called *Hyaloid.* This humour serves to keep the crystalline lens at a proper distance from the retina.

Regarding the means by which we judge of the position and distance of objects, and by which we regulate the movements of the eyes, and adapt them to objects at different distances, it seems necessary to add a few words.

This is an inquiry concerning which many volumes have been written; and much diversity of opinion has prevailed, and still prevails upon it, to discuss which is far beyond the limits of this memoir.

I must therefore content myself by referring the reader to the admirable works of Sir D. Brewster, who has stated (Edinburgh Journal of Science, vol. i. p. 81), "that the power of adjusting the eye depends on the mechanism which contracts and dilates the pupil; and since this adjustment is independent of the variation of its aperture, it must be effected by the parts which are in immediate contact with the iris. And, in evidence of the accuracy of such an opinion, Dr Wells remarked, "that when the muscular fibres of the iris are rendered paralytic by belladonna, the eye loses the power of adapting itself to objects at different distances."

From the experiments of Muck on thirty pigeons, Muller says,* " it may be inferred, that the motor power of the ciliary ganglion and nerves is derived from the third pair, and that the pupil does not contract in consequence of the light influencing the ciliary nerves; but that the irritation of the retina and optic nerve acts immediately on the brain, and from the brain is reflected upon the third nerve, and the short motor root of the ciliary ganglion."

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* *Vide* Physiology translated, p. 772, vol. i.

MAYO's experiments also shew, "that the general sensibility of the eye is given to it by the fifth pair, the ophthalmic branch of which sends filaments to the conjunctiva, while the long root of the ciliary ganglion from the nasal branch of the fifth, supplies the interior of the eye with sensibility."

ROHAULT and VAN DER KOLK, distinguished physiologists, have adopted the opinion of my Father, who supposed that the compression and elongation of the eyeball is brought about by the oblique muscles of the eyeball, by which the distance between the lens and retina is increased, to which the contraction of the orbicular muscle contributed, by rendering the cornea more convex, by which the length of the anterior part of the axis of the eyeball is increased.

Before concluding as to the nervous system, it seems necessary to add a few remarks on the causes of the form of the skull, and on its capacity, to which much attention has been in all ages devoted. Considerable light has been thrown upon this subject by HERODOTUS, HIPPOCRATES, VESALIUS, CAMPER, SOEMMERING, BLUMENBACH, LAWRENCE, GIBSON, MACCULLOCH, PRITCHARD, BARTON, Dr MORTON, and by many travellers. Deeply impressed with the importance of such inquiries, I have been at considerable pains in forming a collection of skulls of different nations, which have been described by Professor GIBSON,* and also by myself in my Elements of Anatomy. Different methods have been proposed for appreciating these differences by DAUBENTON, CAMPER, BLUMENBACH,† MORTON, and myself, all of which are more or less exceptionable. It is much to be regretted that the authors above named have treated the subject as a branch of natural history, and have not combined with it historical research, for they have not endeavoured to explain the source from which the different countries of the world have been peopled, an object of extreme curiosity and interest, or to account for the variety in the form of the skull, a subject of very great difficulty, on account of the frequent conquests and consequent intermixture of races which took place in the early ages of the world; to which is superadded the difficulty or almost impossibility of discriminating between these features which are peculiar to the natives of any part of the world, which have been altered, I may say remodelled, by intermarriage with strangers who may have settled in that country, and also the influence of climate or peculiar customs. The peculiarities of the skull of the Esquimaux are a striking illustration.*

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* De Forma Ossium Gentilitia. Edinburgh 1809.

† *Vide* observations on these in my Elements of Anatomy, vol. i. p. 190, &c. *Vide* in same volume measurements of skulls of different nations, p. 203 and 204.

Dr Monro *secundus*, in his lectures, used to describe and exhibit the diversity in the forms of the skulls of different nations, which he imputed very much to the powerful influence of posture and pressure applied to the head. On this principle, he explained the cause of the round head of the Turk, from the influence of the pressure of the turban; and the flat form of the back part of the German skull, from the children of that nation always resting in the cradle upon the back part of the head.

There is no part of the human skeleton which is more variable in its shape, and in the proportions of its different parts, than the skull, and this is to be imputed to the influence of several concurring causes. The form of the skull is determined in a certain degree by age and sex, and by the brain, as is very evident, when a considerable quantity of water has been collected within the skull. It is also modified by the pressure of the temporal muscles, by artificial pressure, and by climate. Climate has also a remarkable influence on the form of the head, as is seen in the children of the emigrants to America and Australia; with the single exception of Jews, whose features undergo no change.* According to MAGENDIE, the volume of the brain is generally in direct proportion to the capacity of the mind, upon which statement Dr SILLIMAN remarks, "We ought not to suppose, however, that every man having a large head is necessarily a person of superior intelligence; for there are many causes of an augmentation of the volume of the head besides the size of the brain; but it is rarely found that a man distinguished by his mental faculties has not a large head. The only way of estimating the volume of the brain, in a living person, is to measure the dimensions of the skull; every other means, even that proposed by CAMPER, is uncertain."

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* *Vide* Elements of Anatomy, vol. i. p. 217.

In my earlier lectures I used to state, that the Negro skull, and consequently the brain, is smaller than that of the European, an opinion still held by different medical gentlemen who have resided in the West Indies, or our different settlements on the coast of Africa. My friend Sir W. HAMILTON's researches have led to a different conclusion.† TIEDEMANN has observed, that "there is undoubtedly a very close connection between the ABSOLUTE SIZE of the brain and the INTELLECTUAL POWERS AND FUNCTIONS of the mind;" and, proceeding on this principle, he compares the weight of the whole brain, as ascertained in upwards of fifty Europeans of different ages and countries, with its weight in several Negroes, examined either by himself or others. He gives extensive tables shewing the weight of the quantity of millet-seed necessary to fill Ethiopian, Caucasian, Mongolian, American, and Malay skulls; and adds that "the cavity of the skull of the Negro in general, *is not smaller* than that of the European and other human races." The inference which he draws is, that, *intellectually* and *morally*, as well as anatomically, the Negro is naturally on a par with the European; and he contends that the opposite and popular notion is the result of superficial observation, and is true only of certain degraded tribes on the *coast* of Africa. The following are very judicious observations of Dr Silliman, the reviewer of Dr Morton's book. Tiedemann's Essay has been critically examined by Dr A. Combe, in the Phrenological Journal (vol. xi.), who shews not only the error of principle committed by the author in assuming the whole brain to be the organ exclusively of the *intellectual* faculties, but the more striking fact, that Tiedemann's own tables refute his own conclusions." "The descriptions of the mental faculties which distinguish the different families of mankind, given even by the best travellers, are vague and entirely popular. There is scarcely an instance of the specification of well defined mental faculties present or absent in the races, or possessed in peculiar combinations; nothing, in short, which indicates that the travellers possessed a mental philosophy, under the different heads of which they could classify and particularize the characteristic qualities of mind which they observed, as the botanists describe and classify plants, or the mineralogists minerals. The anatomical characters of the races, also, are still confined to a few particulars, and many even of these have been drawn from the inspection of a very limited number of specimens."

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* *Vide* also annexed Plate 6th.

† *Vide* page 39 of this Memoir.

There is the utmost variety as to the capacity of the fore and upper part of the skull of different individuals of the same, and of different nations.* Generally, a large and prominent forehead is an index of superiority of the mental faculties, and a contracted retreating forehead of imbecility of mind or idiotism : and it has been affirmed that the cultivation of the mind leads to expansion of the forehead, and insanity according to Esquirol sometimes produces the opposite effect, an opinion which is to me very doubtful. According to Pinel, certain peculiarities on the fore part of the skull are the concomitants of *dementia* and idiotism, viz. a head laterally compressed, giving a long diameter from the front to the back of the head, and the very opposite condition, by which the skull becomes almost spheroidal.

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* *Vide* Plate VI.

Georget's report upon 500 skulls in the collection of Esquirol is as follows: " In one-half there was nothing remarkable, but in the other, there were peculiarities in the thickness and density of the skull. I have seen the skulls of some madmen very thick and like to ivory in density, whilst others are rather softer and thinner than usual, and one side in some of the cases was more prominent than the other, a character by no means peculiar to the skulls of lunatics. Some of the skulls seemed as if they had been twisted. The skull in many of the specimens projected considerably behind. But these characters may be observed in the greater number of skulls, and are by no means peculiar to those of lunatics.

Mr Belhome's testimony is somewhat at variance with the above, for only 14 out of 100 skulls of idiots in the hospital at Paris, called *Salpetriere*, were of the usual form. As far as I have observed, the skulls of idiots are generally *small* and *depressed* in the fore-head, and I have observed that a depression of the os frontis sometimes gives rise to idiotism.

I very lately took the measurements of a female idiot, æt. 40, and of a male idiot, æt. 28.

[Of Skull of Idiots.]

	Female. Inches.	Male. Inches.
Greatest circumference on the outer side, .	20	$18\frac{1}{2}$
Over the top of the head, from the external passage into the ear to that of the opposite side, .	12	$11\frac{1}{8}$
From the transverse suture at the root of the nose to the back part of the foramen magnum, . .	$14\frac{5}{8}$	$13\frac{5}{8}$
From the meatus auditorius externus to the occipital protuberance, ...	$4\frac{1}{4}$	$4\frac{1}{8}$
From the fore part of the meatus externus to the centre of the frontal protuberance, . .	$4\frac{1}{4}$	$4\frac{1}{13}$
Inside measurements.		
Greatest length from the inner table of the frontal bone to inner table of the occipital bone, . .	$6\frac{1}{2}$	$1\frac{1}{16}$
Inside across skull, immediately above meatus externus,	$4\frac{3}{4}$ & $\frac{1}{16}$	$4\frac{5}{16}$
Depth from fore part of the foramen magnum to vertex,	$4\frac{3}{4}$	$4\frac{1}{2}$

In the female idiot, æt. 40, and who had been idiotical from her birth, the forehead was low, and elongated in the direction of the occipital spine. Osseous spiculæ were observed at base of skull. The cavities for hemispheres of cerebellum were unusually deep, and also sella turcica.

The brain, cerebellum, and medulla oblongata, and spinal cord cut through at the pyramidal bodies, weighed 2 lb. 5 oz. avoirdupois, including the dura mater and arachnoid coat, which was thickened on the upper surface of one of the hemispheres of the brain. Weight of brain of the male, æt. 25, after membranes had been removed, 1 lb. 11 oz., whole brain small. The anterior lobes short, middle lobes broad, convolutions on upper surfaces of hemisphere unusually large, but there was a want of correspondence between those of the opposite hemispheres.

Dr Monro acted as Secretary to the Philosophical Society of Edinburgh, during several years, and discharged the duties of his office with great assiduity. But when, in the year 1782, this society was incorporated by charter into the Royal Society, he was obliged, on account of the urgency and multiplicity of his avocations, to resign his office. He continued, however, occasionally to contribute to the Transactions of the Society, and his papers on the oblique muscles, animal electricity, and his description of a male monster, which were published by the Royal Society, merit particular notice.

Male Monster.

In the year 1792, Dr Monro read to the Royal Society of this place, his description of a male monster, born without a head or arms, and deformed as to the legs, which he illustrated by figures, exhibiting the form, bowels, sanguiferous and nervous systems of the monster. The head, heart, and lungs were wanting. The separation of this monster from the mother proved fatal, and as the heart was wanting, the blood must have been propelled by the muscular power proper to the coats of the arteries and veins. It is evident from this and other examples that the brain is not essential to fœtal life, nor to the functions of animal economy, for there was no emaciation of the body. " As to the nervous system, we," says, Dr Monro, " find in this monster, not only the existence and common appearance of the spinal marrow and nerves connected with it, although the brain and cerebellum were wanting; but we have proof that these, independent of the brain and cerebellum, may actuate the muscular fibres in the vessels of an animal, or that nervous energy, or fluid, as it is commonly called, is not derived from the brain and cerebellum solely; that is, we conclude that the nerves, as well as the brain and cerebellum, are capable of furnishing nervous energy; and that there is no more reason for believing, that the nerves are derived from the brain, than that the brain is derived from the nerves; or all the parts and branches of the nervous system appear to possess the general power or office of furnishing nervous energy."

In the year 1793, Dr Monro published an account of his experiments on the nervous system, made chiefly with the view of determining the nature and effects of animal electricity. Of the results of these experiments an account has been given at page 47 of this Memoir.*

In the year 1794, Dr Monro published his observations on the muscles, particularly on the effects of their oblique fibres, with an appendix, in which the pretensions of Dr Gilbert Blane, that he first demonstrated the same effect to be produced by straight ones, with a less proportional decussation of fibres, is proved to be unfounded. That a greater extent of motion is performed by oblique than by straight muscles, is mentioned by Borelli in his 110th and 111th propositions, and also by Dr Monro *primus*, in his remarks on the articulation of the lower jaw.

My Father published his observations on this subject, because, when he began to deliver lectures in 1759, the structure of the oblique muscles had not been sufficiently examined, nor the number of these attended to, and because their chief purposes or effects had been overlooked.

My Father demonstrated geometrically, founding on the propositions of Euclid, and then arithmetically, 1*st*, That a pair of oblique muscles placed between the same parallels with two straight muscles, perform with the same proportional contraction more extensive motions than the straight muscles can do: and this doctrine he applied to the muscles of the abdomen, the intercostal muscles, muscles of the trunk, penniform muscles of the head, and the muscles of the head.

2*d*, That where two oblique muscles balance each other, the motion of their insertion is more extensive than can be produced by two straight muscles of the same length with the oblique muscles.

3*d*, That the extent of their motion produced by the cooperation of oblique muscles, increases with their greater degree of obliquity: and as the obliquity of an oblique muscle is gradually increasing during its action, its force is diminishing, while its effect of producing extensive motion, is increasing.

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* *Vide* the objections to the Galvanic Theory of Nervous Action in Dr Alison's Outlines of Physiology, and in Muller's Physiology.

4*th*, That both rows of intercostal muscles co-operate, or are muscles of inspiration.

Surgery engrossed a large share of my Father's attention, and I shall now proceed to give a few extracts from his lectures on those branches of surgery on which he had thrown light. His remarks on the puncture of the thorax are mentioned at 5th, on Empyema of this memoir at page 72, Essay 3d. He published in the Edinburgh Physical and Literary Essays a few observations on the mode of removing polypi.

The following is an extract from my Father's lecture on the mode of removing polypi from the Vagina, Nose, and Gullet.

Of Polypi within the Vagina.

Polypi hanging from the os tincæ into the vagina, or growing from the sides of the vagina, may be removed by surrounding the root of them with a flexible silver wire, and tightening it by passing its ends through two tubes joined together.

Of Polypi rooted in the Nose, and hanging down into the Pharynx, or rooted in the Pharynx.

"Levret thought it impossible to apply this last-mentionod method to polypi falling down from the nose into the pharynx, or situated in the throat; and promised to describe some other kind of operation suited to the removal of tumours so situated; but he did not fulfil his intention.* In operating on a polypus of the throat, he began with introducing a speculum oris, then put his ligature into the mouth, and tied it to the tumour in the throat, and then fixed it to one of the grinding teeth."

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* M. Levret sur la Cure des Polypes de la Matrice, de la Gorge, et du Nez, 1749. Nouvelle Methode, article 2d, p. 293.

" Eight years thereafter, to-wit in 1757, he writes as follows in the Memoirs of the Royal Academy of Surgery in Paris.* " La methode que nous avons décrite pour lier les polypes de la matrice et du vagin, est applicable à ceux des narines ; mais quoiqu'elle m'ait déja reussi plusieurs fois, et que je ne sois pas le seul qui en aye fait usage, je n'en dirai rien ici, reservant d'en parler dans un autre memoire en traitant des polypes de la gorge, *pour lesquels la meme methode ne pouvant pas servir*, j'en ai imaginé une autre, que je decrirai alors dans toute son étendue."

" After I had read Levret's treatise on Polypi, I was consulted in a case, so far back as June 1768, in which a tumour, larger than a hen's egg, and of a consistence as firm as the unimpregnated uterus, rooted in the membrane of the cuneiform process of the occipital bone, the sphenoid bone, and back of the vomer, at the top of the pharynx, hung down behind the uvula, so low as to reach the epiglottis. The patient breathed with difficulty when the head was much bended ; had some difficulty in swallowing ; had some degree of dulness of hearing, which I imputed to the pressure of the tumour on the mouths of the Eustachian tubes ; had, in a great measure, lost the sense of smelling, from the stoppage of the back part of the nose ; had an uncommon degree of drowsiness, perhaps from the pressure of the tumour, on the upper part of the internal jugular veins ; and was weakened by the frequent returns of hæmorrhagy from the tumour.

" On considering this case, it occurred to me that a flexible silver wire might be passed through the nose, brought down between the palate and fore part of the tumour, and then raised upwards behind the tumour, between it and the back part of the pharynx, so as to include the root of the tumour: and that the wire might be tightened upon the tumour, so as to take it off, by sliding a tube or two tubes joined together, upon the two ends of the wire. I accordingly found that the operation could, without much difficulty, be executed in this way, and on the third day thereafter the tumour dropt off.

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* Memoire sur les Polypes de la Matrice et du Vagin. Par M. Levret, in Memoires de l'Academie Royale de Chirurgie, tome troisieme, 1757. Pp. 518-99. 4to.

"In the month of November following, I shewed the tumour and instruments I had employed for the removal of it, to the Philosophical Society of this place, and read a very full account of the case.

"In the following year 1769, I was consulted on two other similar cases, and since that time, in three more such cases, which were all treated with success in the same manner; excepting only that I found in these cases, and likewise by experiments imitating the method in the dead body, that thick catgut is far preferable to the silver wire, which is not only apt to break, especially if it be twisted, but is less pliable, and, by being smaller than the catgut, and harder, cuts the surface before the circulation has ceased, and occasions hæmorrhagy.

"In three of these cases, where, after the ligature had cut off the tumour, the root of it seemed to be remarkably firm, I applied to it a caustic repeatedly, for the space of a week, by an instrument I contrived for the purpose,* and in order to prevent danger from particles of the caustic being broken off and swallowed, I covered it with thin muslin.

"I had the opportunity of examining or hearing from the first four patients, and the sixth, on whom this operation was performed, during a space of from five to twenty years, and found that there was no return of the tumour in any of them, nor do I know that it returned in the fifth patient on whom it was done, who went to sea soon after the operation."*

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* *Vide* figure of this instrument in my Thesis de Dysphagia, Edinburgh 1797.

Of Polypus of the Uvula or Velum Palati, or hanging from the Amygdalæ.

"In 1770, I was consulted along with Dr Rutherford senior, Dr C. Drummond, Mr Alexander Wood, and Mr Williamson, surgeons, by an elderly lady in whom the uvula was enlarged to the size of an egg, and was smooth on its surface, and firm in its consistence. In her case I proposed to try the method which had succeeded in the three former similar cases, or to pass a catgut, doubled at its middle, through the nose into the pharynx, then to pull it forwards into the mouth, and with the finger to raise it to the fore and upper part of the tumour."

After which, keeping the catgut with the finger close applied to the root of the tumour, to pull backwards the catgut, and, having slid a double tube through the nostril along it, to tighten the catgut upon the root of the tumour. This was accordingly executed with complete success; and the sides of the large opening made in the middle of the palate, by removing the uvula, were lined with membrane, and quite healed in about ten days after the tumour was separated.

Several excrescences from the amygdalæ, with narrow roots, have been treated in the same manner.

But if a tumour in the uvula or palate is of a conical shape, and so broad at its root that it cannot be surrounded by a ligature in the way I have been describing, I would advise two threads of different colours to be passed through it, with Cheselden's needle; or through such a needle with its point bent forward, and entered behind the palate;

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* Dr Monro secundus states, "I allowed Mr Benjamin Bell, which he mentions, to copy and publish in his 4th volume, Plate XXXII. Fig. 1. Plate XXXIII. Fig. 4; and Plate XXXIV. Fig. 1.—plates which had been drawn and engraved by my direction, representing the instruments and methods I had employed."

then to tie on these opposite sides of the tumour, and either to cut the threads short, or to draw them upwards through the nostrils, and to pass two single tubes, one through each nostril, along them to tighten them."

Treatment of a large Excrescence or Polypus within the Œsophagus.

" I shall now turn your attention to the treatment of a tumour which was rooted in the œsophagus, between the larynx and cardia: It was so long, that, on exciting the action of vomiting by irritating the fauces, it was inverted and thrown upwards, through the mouth, the point of it reaching to the chin, so that, in its usual position, the lower end of it must have been within the stomach.

" Mr DALLAS, surgeon, under whose care the patient was treated in our Royal Infirmary, by changing the position of HILDANUS's ring, which I shewed him, included within it, and cut off with the ligature, a considerable portion of the lower end of this tumour, which, by the effort of vomiting, had been thrown upwards through the ring into the mouth."*

" But I apprehend the operation might have been made much more complete, by throwing a doubled catgut over the tumour, after, by the effort of vomiting, it was brought up into the mouth ; then allowing the tumour to carry the catgut down with it into the œsophagus ; after this, the piece of catgut might have been drawn upwards into one of the nostrils, by means of another piece of catgut passed through the nose into the throat and tied to it.

" In the last place, by a flexible tube or flexible catheter, passed downwards along the catgut, from the nose into the œsophagus, as far as the root of the tumour, this might have been so compressed as to have cut it, and produced the separation of the whole tumour from the œsophagus.

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* See an account of the case in the Physical Essays of Edinburgh, vol. iii. Arts. xxvi. and xxvii.

" If laryngotomy, which can be executed easily and without danger, had been in the first place performed, which I had proposed to Mr Dallas to do before he attempted to apply the ligature, the operation I have above proposed might have been completed without any danger of suffocation."

In one of the subsequent essays, Dr Monro's observations on aneurism are given.

Of Hydatids.

According to Rudolphi, hydatids form the envelope of a genus of animals, which he calls *Cystocercus*. In my Morbid Anatomy of the Gullet, Stomach, and Intestines, I have described six kinds of hydatids at considerable length, their bloodvessels, nerves and absorbents, and also the different states in which these animals are found, together with their effects upon the organ in which they are imbedded, and the symptoms which they occasion.

Of removing Hydatids from the Liver.

Dr Monro was, I believe, the first person who proposed an operation for the removal of hydatids from the liver. In a former work,* I have described, at considerable length, the structure and habitats of these worms or hydatids, which are common to man, and to the inferior animals. There are six different kinds of human hydatids, which are not peculiar to any one tissue, but occur in every part of the body, and most frequently in the liver. They are very various in point of size; some are not larger than a millet-seed, whilst others are as large as an ox's bladder. They are composed of two coats, which form a globular tumour, filled by a watery fluid, which to the taste is salt, and also by a number of very small hydatids. These animals are incapable of an independent existence, and therefore exhibit a contractile power only immediately upon being discharged from another living animal, in whose body they have been lodged.

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* Morbid Anatomy of Gullet, Stomach, and Intestines. 1st and 2d Editions.

These hydatids sometimes give way within the sacs which contain them, and it is very remarkable that a part of the organ which contains the hydatid is sometimes removed by absorption, and, in the case of sheep, the hydatid lodged within the brain creates a remarkable softness in that part of the skull which lies over the hydatid.

It may be added, that there is a much greater disposition to the destruction of the cyst which contains a living hydatid, than when water has been accumulated within it.*

I have inserted the following very interesting cases of hydatids connected with the liver, which were treated by my Father. The late Mr William Anderson, surgeon in Edinburgh, carried my Father to visit a man, 40 years of age, who had a swelled liver, which was followed by ascites, jaundice, and the discharge of hydatids by stool, and who died in the course of six weeks. My Father expected to find a sac with hydatids attached to the stomach or intestine, and communicating with them ; but instead of this, the outer part of the sac containing the hydatids was found entire, and did not adhere to the alimentary canal. On opening the cyst, the concave part of the liver was found wasted to a considerable depth, and at the bottom of the cyst the branches of the biliary ducts were seen without dissection, bare, and greatly enlarged, with a number of holes in their sides, through which the hydatids had passed into the duodenum.

The great enlargement of the biliary ducts was probably produced by the irritation of the hydatids, and by the mechanical obstruction caused by the pressure of the hydatids upon the lower ends of the biliary ducts, to which the pressure of an enlarged lymphatic gland, which lay over the common duct, had probably contributed.

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* *Vide* illustrative cases in my Morbid Anatomy of the Gullet, Stomach, and Intestines. 2d edition.

In the year 1783, my Father was consulted by Mr ——, 12 years of age, who had a swelling in the upper and right side of the belly. The swelling gradually increased very considerably. In the under part of the swelling, the liver was found in a sound state. At last the fluctuation of a liquor above the solid part of the tumour became very obvious.

As the patient had not lost his appetite for food, had no frequency or fulness of pulse, no bilious disorder, no symptoms of inflammation, suppuration, or of scirrhus in the liver, my Father imputed the fluctuation which he perceived, on applying one hand to the upper part of the tumour, and striking it with the other, to hydatids, contained in a sac above the liver, between it and the diaphragm; and the gradual descent of the body of the liver, to the increase of the sac containing the hydatids. As the tumour continued to increase in size, my Father proposed to the late Mr William Inglis and Mr F. Dewar, surgeons, who were called in, *to make an incision into the sac*, which was agreed to, and performed with much caution.

The peritoneum lining the containing parts was found to adhere to the cyst, which, from the long continuance of the swelling, was formerly suspected.

Upon dividing the external coats, a thick but soft semi-opaque membrane presented itself, and on cutting this, 8 lb. of a clear liquor were discharged, but no small hydatids. On examining the soft membrane within which the liquor had been contained, it proved to be of the same structure as other hydatids, and the coats were somewhat thicker than any of these, owing probably to its greater size.

My Father now laid hold of the large hydatid with his fingers, and, by pulling it gently, he detached the whole of it from the tough, external coat, formed by the peritoneum, which inclosed it.

After the operation, the wound was carefully covered by pledgets, and thick compresses, over which a broad flannel roller was applied, in order to exclude the air, and to keep the opposite side of the cyst contiguous.

In a few days the patient became feverish, he suffered much from thirst, his pulse was quicker than common, and there was a discharge of purulent matter from the sore, a sufficient proof of previous inflammation in the sides of the cavity.

The cure was completed within ten weeks. I have seen the patient frequently since the operation. He has had no return of the complaint. He is now 49 years of age, and enjoys perfect health, and is one of the stoutest men in Edinburgh.

Within these few years, a similar mode of treatment has been adopted by others with similar success.

During the performance of operations upon the liver, little or no blood is lost.

I have ascertained by experiment, that a portion of the liver of a healthy animal may be cut off, and the bleeding may be stopped by pressure artificially applied to the liver.* This experiment I performed upon a rabbit many years ago with the most perfect success. But when the liver has been ruptured in consequence of external violence, of which I have seen four examples, the patient dies in the course of two or three days from loss of blood, and upon a *post-mortem* examination, a considerable quantity of blood is found in the abdomen.

OF INTESTINAL CONCRETIONS.

In the following paragraphs are embodied the substance of my observations on alvine concretions.

1*st*, That the greater number of intestinal concretions consist chiefly of fibres of the beard of the oat, which are intimately matted together, and which probably have been attracted by a central nucleus.

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* *Vide* also my Elements of Anatomy, vol. 1st p. 567. Edinburgh, 1825.

2*d*, That intestinal concretions occasion a derangement of the functions of the alimentary canal, and create griping, obstinate and long continued colicky pains, which are generally limited to that part of the intestinal canal which contains the concretion, and which are occasionally more severe upon the patient taking acids, or food of difficult digestion.

3*d*, That intestinal concretions may be generally felt within the intestines, and when two or more of these are lodged within the intestines, they may be made to strike against each other.

4*th*, That intestinal concretions frequently change their situation and pass down into the rectum, which is thereby much distended, and, when so situated, they occasion acute pain and sense of weight in the back part of the pelvis, with a constant desire to go to stool, which the patient cannot gratify ; and they may, by the finger, or by an instrument introduced into the rectum, be felt within it.

5*th*, That intestinal concretions, formed within the human alimentary canal, are, in some cases, discharged by vomiting, or along with the fæces.

6*th*, That an intestinal concretion, after a certain time, cannot be moved from one portion of the alimentary canal to another, owing to its increase in bulk, to the expansion of the coats of that part which contains the concretion into a sac, and to the unnatural constriction immediately below the seat of the alvine concretion.

7*th*, That intestinal concretions must prove a mechanical obstruction to the passage of the aliment through the intestines ; and if proper means be not taken to remove the cause of the obstruction, inflammation of the intestines follows, which proves fatal.

8*th*, That in the earlier stages of the disease, while the concretion may be moved from one part of the intestines to another, all that can be done is to operate on the bowels, partly through the medium of mechanical action, and partly by lubricating the alimentary canal by the exhibition of proper medicines, in order that the concretion may be discharged along with the fæces, or may descend into the rectum, from which it may be artificially extracted.

9*th*, That after the disease has been of long standing, and when a sac has been formed which retains the concretion in a certain place, it cannot be removed (should it be lodged within the colon) but by an incision, as there is little or no chance of dissolving the stone within the intestine by any medicines given internally.

Cruveilhier in Anat. Pathol. liv. xxvi. has made mention of a case in which there was a large collection of cherry stones in the cæcum, and a part of the colon: the transmission of which had been intercepted by stricture of the colon. There were symptoms during life like to that of crepitation.

Carbonate of magnesia or of iron, when taken in large quantity, has sometimes proved a cause of obstruction to the progress of the contents of the intestinal tube.

I have given a full account of the nature and effects of alvine concretions, and also of the mode of removing them, in the 1st number of Mr Costello's Cyclopedia of Practical Surgery.

Very frequently intestinal concretions have attained so large a size, as to be in a great measure immoveable, and by becoming on the surface lobuled and encrusted by layers of the phosphate of lime, they become fixed in one place. In some instances the concretion has stuck at no great distance from the anus, and has been extracted by long forceps after an emollient clyster has been administered. But there are instances where this is impossible, and as such substances cannot be dissolved by any medicine which may with safety be given, in order to obviate the very acute suffering of the patient, the inflammation of the bowels, consequent to the obstruction, and the certainty of death, my Father proposed to make an artificial opening into the intestine, with the view of extracting the concretion.

I have given insertion to my Father's description of the operation, which is contained in a letter he wrote to Dr Hall. If they (the intestinal concretions) shall, by increasing, or by change of place, obstruct and stop the passage entirely, it is, I apprehend, possible to save the life of the patient, by taking them out by an operation. For, as the colon is, on its back part, not covered by the peritoneum, but connected by cellular substance only to the muscles, if an incision be made on the posterior part of it, between the twelfth rib and upper part of the ilium, or immediately above the ilium, *the colon may be opened, without opening into the cavity of the belly; and the wound, I have little doubt, could be cured without much danger, especially as, in the course of last year, I have seen it in one case wounded by a pistol ball, and in another eroded at this very place; and yet in both the openings were healed soon.**

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* As the success of the cases related in the London Medical and Physical Journal, vol. xlvi. p. 72, &c. in which an artificial anus was formed by an incision into the colon a little above its sigmoid flexure; and as an extensive intusceptio was removed after having opened the containing intestine, (*vide* Hufeland's Journal for Feb. 1825), may turn the scale in favour of the mode of operating which was adopted in these cases, I have subjoined the subsequent narrative communicated by Mr ——— to Mr Benjamin Forbes, as a counterpoise.

"29 *Drummond Place*, 18*th April* 1826.

"Sir,—The patient I mentioned from whom the alvine concretion was extracted, was a man about 38 years of age. For more than twelve months, by his own account, he had been distressed with bowel complaints, frequent gripes, and costiveness, for which he had been ordered

If, therefore, these balls are not passed by stool, nor moved from their present place by the medicines, and the pains grow intolerable; or if there shall happen a stoppage of the fæces through the canal, by these balls enlarging, or changing place with respect to each other, I would recommend that an operation shall be performed in the following manner:

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a variety of laxatives, clysters, &c. which, in general, produced watery fetid evacuations, and gave temporary relief. He was considerably emaciated, but could walk six or seven miles. When I examined his belly, he pointed to the right side of it; and about three inches from the navel obliquely outward, there he said he had the most pain. At first I took it for an enlarged lymphatic gland, about the size of a goose's egg; but it had quite a different sort of feel from that of a hardened gland. From all the symptoms, and repeated examinations of the affected part, I concluded that it was what it turned out to be; and I told him that it was too large and hard ever to be expelled by laxatives—and that the only way that I could rid him of it, was by an operation fully more doubtful than cutting for the stone; he then told me that he was willing to take his chance at all peradventures. The operation was done in manner following:—An assistant, with one hand on each side of the tumour, pinched up the skin and teguments, so as to keep the lump steady and prominent. After this, an incision was made, the full length of the tumour, through the skin and cellular substance, so as to lay bare the gut; the last incision was made through the intestine crossways, then with the two forefingers within the gut, like forceps, the tumour was extracted. In less than twenty-four hours, the patient was seized with violent abdominal pains and vomiting, and died.—In this case if I had opened the tumour by caustic, I am persuaded the patient would have had a much better chance of recovery; but the man was extremely anxious to have the operation tried.—I mentioned to you that I had different cases, where a gut was opened in consequence of an abscess, and where the fæces were discharged at the opening for weeks; yet the patients got well. In one case, a woman, six months gone with child, had an opening as above mentioned, got well, and was safely delivered. From these instances, I am led to think, that Nature, in her slow way, with the assistance of caustic, would do better than the knife in alvine concretions, such as the one here mentioned; but I must refer to Dr Monro, who has had much more experience in these matters than I could have had."

Let an incision be made from the twelfth rib, at the distance of two inches from its point, directly downwards to the top of the os ileum. Then cut slowly, and with great caution, inwards and forwards, till the back of the colon is laid bare for a little way. Then, with one hand, press on the fore part of the tumour, and, with a finger of the other hand, try whether you feel the tumours within the colon. If you think you do, make a very small hole in the colon, and introduce a probe; and, by that means, make it certain that the balls are there, by touching them with it. Then, with the greatest caution, enlarge the incision as much as is necessary, for introducing a pair of forceps, such as are used in lithotomy, for laying hold of and extracting them. After they are extracted, and the fæces that may be collected there are pressed out at the wound, let the sides of the incision be pressed together, and let the external part of the incision be stitched, by sutures passed through the skin, at the distance of a finger-breadth from each other. Cover the stitches and incision with straps of adhesive plaster, and with thick pledgets spread with ceratum simplex, and with a compress and bandage, so as to exclude the air.

Extract from the Lectures of Dr Monro *Secundus, on the Treatment of Luxations.*[*]

In the anatomical part of my course of lectures, I shewed the dislocations of the principal bones of the body, explained the manner of distinguishing these in a living person, and, of course, the mode of treatment.*

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[*] This subject engaged the attention of Dr Monro when he began to lecture, and he had the gratification of finding several of his observations confirmed by his very distinguished pupil Sir A. Cooper, who, in a letter, observed to me, " I attended your father's lectures with great pleasure and instruction. Your Father had great zeal, great industry in obtaining knowledge, and much clearness in imparting it. Cullen, Black, Gregory, and Monro formed a galaxy of talent which raised the reputation of Edinburgh to its highest pitch of excellence."

In the lectures I delivered on the bones, in 1753, I observed that it seemed to me probable, that the ligaments which possess but little elasticity could not be stretched so much, as to allow the heads of the bones to be entirely moved from their sockets without being torn. Accordingly, in the following year, 1754, on putting this matter to the test of experiment, I found, that although I relaxed the joints of dead bodies, and particularly that of the humerus, by macerating them in tepid water, it was impossible to luxate the head of the humerus, *without at the same time lacerating its capsular ligament.* This opinion received confirmation from a preparation of the scapula I purchased from Dr Loeseke in 1757, of which he published a figure, a new socket was formed on the anterior part of the neck of the scapula,† at a distance from the glenoid cavity.

This opinion, long ago maintained as probable by Petit, surgeon,‡ was not attended to by succeeding writers and practitioners, who very generally stated, that, when a bone has been dislocated, the capsular ligaments were merely stretched.||

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* The muscles and their tendons in the vicinity of a joint, or which cross over it, give great support to it, and prevent dislocation, and hence if these muscles and their tendons, which pass over the capsular ligament of the shoulder-joint, be removed, and the bare capsular ligament be left, the weight of the arm hanging by the side will occasion a subluxation of the shoulder-joint, and, further, if the same muscles become paralytic, by a very slight degree of violence, the ball of the os humeri is displaced.

† Loeseke, Obs. de Nova Acetabuli Scapulæ formatione, 1754.

‡ Petit Mal. des Os, t. i. p. 47. " On est obligé de suivre ce chemin ——parce qu'il conduit à l'ouverture de la poche ligamenteuse qui a eté fait par la sortie de la Teste d'los."

|| Heister, p. 226, writes as follows, " Nisi enim vi prolapsa mem-

Six years thereafter, to-wit in 1763, I had the opportunity of dissecting the arm of a person who had been killed by a fall from the top of a high wall, and who, in attempting to save himself, had dislocated his humerus. I found the capsular *ligament, and synovial membrane, very considerably lacerated*, and other changes produced upon the muscles. Sometimes the articulating processes of the bones are broken.* Since that time I have met with one case, in which the head of the luxated humerus was lodged in a new socket, and tied by new ligaments to the scapula ;† and another, in which the head of the os femoris had, for upwards of twenty years, been lodged under the glutei muscles on the back part of the os ilium.‡

In several books there are tables representing new sockets formed by dislocated bones, at a distance from the sockets which originally contained them,§ whilst the original socket is, in a greater or less extent, filled up by bony substance, and considerably altered in form.||

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brorum ossa, post graviorem ejusmodi Ligamentorum Distentionem opportune reponatur.

Plater speaks of relaxations, but says nothing of their laceration.

* The ligaments admit of such considerable elongation as to admit of dislocation without any degree of laceration, more especially in the scrofulous and gouty, and also when an unusual quantity of synovia has been secreted.

† Acta Med. Berolin. vol. x. p. 107.

‡ Thomson, in London Med. Ess. v. ii. 1762, Art. 29, and Pl. 3 and 4. Molle, in 1770. Sir A. Cooper on Dislocations. Bonn, in 1782. Callisen, Chir. t. 2, DCCCXLVI. Fissuram Ligamenti Articularis comperit.

§ Loeseke, et M. Morand, Mem. de l'Acad. de Chir. t. ii. 5153.

|| When a dislocation has been of very considerable duration, the muscles are very much shrunk, or often converted into a substance like to a ligament. The adaptation in the vicinity of a dislocation of muscles

Before proceeding further, I shall state the general causes which render it difficult to reduce a recent luxation, and the causes of the still greater difficulty of reducing bones, which have been for months displaced;* and, lastly, the mode of treating luxated bones.

There are various obstacles to the reduction of bones recently luxated.

1st, The edges of the lacerated ligament may catch the head of the luxated bone, though the capsular ligament be torn to a considerable extent.

2d, In such joints as are moved, like a hinge, in two directions only, the lateral ligaments, which are thick and strong, may fall over the neck of the luxated bone, and prevent the easy reduction of its head. Such was also the opinion of Desault and Boyer.†

That as the diameter of the head of the luxated bone and brim of the socket is greater than the neck of either, it follows that the head of the luxated bone may fall in upon the neck of the socket, or the brim of the socket may fall in upon the neck of the luxated bone; or both bones may be thus entangled or notched together.

3*d*, The tendons of the muscles originating from, or inserted into, the ends of the bones (in order to render our motions quicker) may fall across the socket of the dislocated joint, and prove an obstacle to the return of the head of the luxated bone into it.

4*th*, The muscles, at the dislocated point, must be

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to their proper functions is very remarkable, so that after a time, the victims of dislocation have regained the power of walking, though the dislocation has not been reduced.

* A dislocation of three or four months' duration can very rarely be reduced.

† Sir A. Cooper is opposed to such an opinion.

stretched, lacerated,* and irritated; in consequence of which the muscles will very soon be contracted, inflamed, swelled, and shortened, or rendered tense.

5*th*, Upon employing force in order to stretch the parts around the joints and disengage the bones, the muscles react, and may be spasmodically affected, and, therefore, powerfully resist the attempt of extending them.

The difficulty of the reduction becomes still greater by delay, because,

1*st*, The lacerated ligament may close around the head of the luxated bone.

2*d*, The muscles, irritated, become shorter, rigid, and often inflamed; and the cellular substance around becomes much thickened.

3*d*, Adhesions of the several parts take place; and indeed sooner than is supposed, especially in young subjects, and in the smaller joints.

4*th*, The head of the luxated bone swells, and the edges of the socket become altered in their shape.

5*th*, Exostoses may form where the neck of the luxated bone rubs against the edge of the socket, and the two bones may be notched together by these, as was found in the case of FORREST, examined by my father.

The shape of the socket is altered by the pressure made upon its sides or edges, and by the irritation, inflammation, and increased absorption this occasions; and, in some cases, the socket is much diminished in size.

General Rules to be observed in Reducing Luxations.

If there be much pain and swelling, venesection (in order to induce fainting), the application of leeches, purgatives, fomentations, perhaps poultices also, are used; and particularly venesection immediately before reduction, so as to bring on relaxation and faintness.*

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* This sometimes happens from the injurious and sudden manner in which extension is made in attempting to replace the bones.

The time after the accident at which a luxated bone may be reduced, varies according to the age, constitution, violence of accident, and the immediate treatment after it.

"I find, by notes of cases on which I had been consulted, that the humerus was reduced in adults,—in one case, four weeks after its luxation, and in another, after five weeks; two cases of the reduction of the fore arm in young persons, three weeks after the accident; one case of the reduction of the great toe of an adult, ten days after its luxation. The displaced bone may shift its place by the action of the muscles upon it; therefore, the situation of the limb at the time of the accident ought to be attended to, in order to judge better of the place at which the ligament has been lacerated."

The muscles which have been overstretched should be thrown as much as possible into a state of relaxation.

The limb is to be placed in that direction in which it was at the moment of the luxation, or when the head of the bone passed through the ligament, as this will be the most favourable for the reduction.

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* Nauseating dozes of tartarized antimony frequently produce the happiest effects, especially after bleeding has been premised, in order to keep up the approach to syncope.

A tobacco clyster proves, on many occasions, a very useful auxiliary.

Dislocations of some duration, according to some authors, should be treated in a different way from such as are recent. Thus it is said, that, by repeated and daily extension, the morbid adhesions are elongated: but by this mode of practice, inflammation has sometimes been excited, which has proved the cause of the patient's death. If the head of the bone become loose, an attempt is then to be made to return it into its original socket; but if a new socket be formed (as is indicated by the patient having regained the power of voluntary motion over the dislocated member), no attempt at reduction should be made, because it cannot fail to be abortive, the old socket being altered in form, and diminished in size.

By the hands or machinery, the displaced bones are to be drawn asunder; in doing which, it is improper to strain any other joint but the luxated one;* and care should be taken, that the machinery does not press on, stretch, fix, or tie down any of the muscles or tendons which pass over the luxated joint, or over the space through which the head of the luxated bone must pass in its way to its socket. Thus, the tendon of the large pectoral muscle should not be pressed upon when the head of the humerus is lodged under or behind the belly of that muscle, which it often is.

The whole body of the patient is next to be fixed.

The two bones which press against each other are to be disengaged, before attempting to extend the limb. From want of attention to this, we have known surgeons of reputation foiled in their attempt to reduce the recent luxation of the thumb and great toe.

The one bone is to be fixed, whilst the other is pulled; or they are to be pulled in opposite directions. The force of the extension ought to be increased by slow and gradual degrees; lest, by increasing it suddenly, the joint and muscles be materially injured and torn. Sometimes we succeed by perseverance and fatiguing the muscles, without increasing the force of the extension; which can be better done by pulleys than by any other means.

When the two bones are fully separated from each other by the extension, coaptation is to be performed.

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* This rule is not attended to by Boyer and Richerand, vol. ii. pp. 90, 108, 136.

OF LUXATIONS OF THE HEAD.*

Various cases have been recorded, in which the head carrying the first vertebra with it, has been thought to have slipt off from the second vertebra, called dentata, and to have been reduced by fixing the shoulders, pulling the head upwards, with the view of disengaging the edges of the oblique processes of the two vertebræ, and then turning it round to its proper situation.

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* BOYER and SANDIFORT have described displacement of the atlas as an effect of disease. According to RUST the symptoms are, pain on one side of the neck which is more acute at night, or in swallowing a large mouthful, or drawing a deep breath. The difficulty in swallowing and breathing increases, alternating with pain in the neck. The head sinks towards one shoulder, if both sides are affected, the head inclines forwards. The above symptoms increase in severity, the patient feels as if his head was too heavy, he supports it with his hand, when he moves from the sitting position, or *vice versa,* this is the most marked pathognomonic symptom. Cramps and partial convulsions of the upper limbs succeed and hectic fever. The slightest pressure on the upper part of the neck is painful, and sometimes a grating noise is heard when the head is moved. The patient at length dies exhausted. I have seen two or three specimens of this disease, and in one of these there was extensive scrofulous caries of the under jaw-bone. The following interesting case of this disease was treated by the late Dr BUCHAN. " A man of colour, aged 21, athletic, was admitted 12th October 1824, affected with complete inability to move the head either in a vertical or lateral direction, in consequence of constant deep-seated pain below the mastoid processes, and in the back of the neck immediately below the occipital bone. Any attempt to move the head was productive of exquisite anguish, accompanied by profuse cold perspiration, but *firm pressure on the cervical vertebræ, below the second, was not attended with inconvenience.* He complained of constant intense headach, with pulsation in the temples and forehead, and of a painful throbbing in the cheeks, jaws, and teeth, resembling toothach. The pain sometimes descended along the sides of the neck to the summit of the shoulders. These symptoms were greatly aggravated by stooping, and by taking warm or stimulating food, and were alleviated at pleasure by pressure on a portion of the neck, corresponding with the situation of the carotid arteries. Latterly, he complained of pain in the throat, with dysphagia. No redness or swelling existed in the fauces. Pulse was 90°, full and strong. Tongue thickly furred and white. Bowels torpid. Bad sleep. The pain, with some degree of rigidity, was experienced ten months previous to admission, was considered rheumatic, and ascribed to cold contracted by frequent alternations of temperature. Had never received an injury of the head or neck. Three weeks before admission, the symptoms sustained a remarkable aggravation, and the fixity of the head became complete.

But it appears to me extremely probable, that in most of these cases, *the shock alone produced insensibility, and that the patient would have recovered, though nothing had been done.* But, as it is by no means improbable that such a luxation may happen, and that the patient may be saved by reducing it, hence, where this luxation is suspected, it is expedient to try whether the head can be moved in the usual manner. If this can be done, *there is probably no luxation.* But if there be a resistance to the rotation,

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" Treatment after admission consisted in the frequent application of leeches, blisters, issues, with aperients, anodynes, &c. Temporary relief was experienced, but he became progressively weaker. On the day preceding dissolution, he complained of numbness of the extremities, which, on the following morning, was converted into paralysis, particularly of the right side. Whilst in the act of being raised from the recumbent position, the head suddenly fell forward and he instantly expired.

" *Dissection.*—Serous effusion under the arachnoid coat of the brain. 1 oz. of fluid in the lateral ventricles, on raising the cerebellum, much sero-purulent fluid exuded from the foramen magnum, the transverse ligament of the atlas was found to have been partially ruptured, and the processus dentatus denuded of its periosteum, and free from all ligamentous attachment, presented a scabrous surface at the base of the skull. The external margin of the foramen magnum, and the superior surface of the atlas, were more or less carious, and the articulating processes on the right side were deeply excavated. In this point the transverse ligament had been extensively absorbed, and had finally allowed the odontoid process to escape from its grasp, though without a complete rupture. The spinal marrow was healthy, but the ligamentous substance lining the vertebral canal was softened and of chocolate colour. The disease did not extend below the vertebra dentata. The muscles attached to the vicinity of the foramen magnum were in a state of complete suppuration, and about 1 oz. of pus exuded when an incision was made through the posterior muscles of the neck."

it may be concluded with much probability, that the first vertebra has slipt off from the second, and that the edges of its oblique processes are kept fixed under the edges of the oblique processes of the vertebra dentata."

"In these circumstances, after fixing the shoulders of the patient, the head should be turned a little farther round, with the view of disengaging the edges of the oblique processes of the vertebræ, and then an attempt is to be made to extend and replace the head."

"*The processus dentatus has been fractured.* One such case, which proved fatal in a few days, occurred many years ago in our Infirmary, under the care of Mr WILLIAM CHALMER, who, after the death of the patient, dissected the parts carefully, and sent me the fractured processus dentatus."

It is possible, if the other parts of the spine were much bended, and a violent blow then given to them, that the oblique processes of one or more of the vertebræ may be luxated;* and that they may be reduced by increasing the

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* Several cases of dislocation of the vertebræ of the neck have been recorded by Mr LAWRENCE (*Vide* Med. Chir. Trans. vol. xiii.) and other distinguished surgeons. During several years I have exhibited a specimen, in which the odontoid process of the second cervical vertebra has been displaced, and diminished very much the canal for the spinal cord. This dislocation did not prove fatal for some time, in proof of which, anchylosis had taken place between this vertebra and the atlas. Cases somewhat similar have been described in the Medical and Surgical Edinburgh Journal of April last, and also in the July number of the Lancet for 1840. "The odontoid process, by its pressure, had reduced the spinal marrow to nearly one-third of its bulk, yet although the accident dated from several years, no symptoms of paralysis had occurred during life." The same happened in the case described in the Edinburgh Journal; the odontoid process was thrown backwards, so as to approach within three lines of the anterior surface of the posterior segment of the atlas. The membranes and substance of the spinal marrow were healthy, and also the nerves arising from its cervical portion.

Sir C. BELL (*Vide* Surgical Observations, vol. i. p. 148) has made mention of two cases of subluxation of the spine. In the first the lower dorsal vertebra was dislocated, and in the second the last cervical vertebra was separated from the first dorsal, the former patient outlived the flexion of the spine, and then making pressure upon the luxated vertebræ.

" By still greater violence, the intervertebral cartilages have been lacerated, as well as the capsular ligament of the oblique processes, and a complete luxation occasioned; and, what is almost incredible, considering the situation and danger attending injuries of the spinal marrow, some have survived such injuries for a considerable length of time, and a few have been completely cured.*"

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injury, but not the latter, and, upon dissection, a considerable space intervened between the displaced vertebræ, and the intervertebral substances were destroyed, and the injured part was surrounded by a large quantity of pus.

* Dr MONRO secundus has stated, that in one case which he attended with Mr ALEXR. WOOD, the patient, a stout man, fifty years of age, was thrown upon his back in wrestling; and, after his death, which happened in six hours, the fourth vertebra of the neck was found to be completely separated from the fifth, yet the spinal marrow was not lacerated. A similar case is described by DUPUYTREN, surgeon of the Hotel Dieu. See Journ. de Med. t. ix. an xiii.

The celebrated Dr FRANKLIN told my Father, that a person of his acquaintance in America, was, by a fall from his horse, instantly struck with palsy of his arms and legs, without loss of judgment. He survived in this state many years: his head was turned a little to one side, from which a luxation in the neck was suspected to be the cause.

SELLIE and CALLISEN, Chir. DCCCLXIII, describe a cure of luxation of the neck, followed by the anchylosis of two of the vertebræ. A cure of the dorsal vertebræ is given by RIEDAGAR. A case in which the last dorsal and first lumbar vertebra were broken and luxated, is stated by DUPUYTREN, Journ. de Med. t. ix. an xiii. It proved fatal on the seventh day.

The late Dr BLAIR, Professor of Practical Astronomy in this University, treated a sailor, twenty-four years of age, in which there was a complete separation from each other of two of the undermost lumbar vertebræ, by his falling down a hatchway, upon his back, among shot. The Doctor was so certain of the fact, that he instantly made a large incision in the back part of the loins, and found two lumbar vertebræ separated from each other, and the spinal process of one of them fractured. By means of a pair of large pincers, he elevated the lowermost vertebra,

Of the Luxation of the Lower Jaw.

"The lower jaw of the adult is not unfrequently luxated in yawning, or by a blow. The luxation is sometimes on one side only; but generally both condyles go out at the same time. If it is on one side only, the chin is turned a little towards the opposite side.

"This accident may be distinguished by its coming on suddenly during yawning; by the pain it creates, the impossibility of shutting the mouth, the hollow or hollows felt behind the roots of the zygomatic processes; and, by feeling the condyles of the jaw on the fore, instead of the back, parts of the roots of the zygomatic processes.

"The reduction is to be made by drawing or pushing forward the condyles a little, in order to disengage them from the fore-parts of the roots of the zygomatic processes, and by pressing the lower jaw downwards and backwards; for which purpose the surgeon passes his thumbs into the mouth, and, having laid hold of the lower jaw, pulls its angles a little forwards, and then with the thumbs pressing the backmost molares downwards; as soon as the jaw yields, the thumbs are to be removed, lest they should be hurt by the sudden and involuntary action of the levators of the jaw.

"The following more effectual method seems preferable. In the first place, let an assistant, placed at the side of the patient, hold the head fixed, whilst another assistant placed behind the patient, presses the lower jaw forward, with his hands placed on its back part, between its condyles

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which was depressed. The Doctor saw the patient next year in perfect health. At first sight the dislocation in this case seems more dangerous than the others I have described, as the blow which had separated the lumbar vertebræ must have been very violent; but, when we reflect that the spinal marrow terminates at the second lumbar vertebra, we perceive that the danger was in reality less, as the nerves composing the cauda equina are capable of sustaining a shock with less injury than the tender medullary matter of the body of the spinal marrow.

and angles, in order to disengage its condyles from the zygomatic processes.

"Let the surgeon, then, after having placed a piece of strong tape over the molares of the under jaw, with this draw the jaw downwards and backwards."

Of the Luxation of the Clavicle.[*]

"Boyer has made mention of the case of a young lady, whose collar-bone had been displaced in consequence of drawing her shoulders forcibly backwards. The outer and upper end of the clavicle being firmly connected to the scapula, which readily yields and eludes an injury, a luxation of it almost never happens.

"But the inner and lower end of the clavicle of the female, on account of the greater shallowness of the articular cavity of the breast-bone, though strongly tied to the sternum, has been frequently luxated, because violence applied to the acromion, acts against its capsular ligament with the advantage of a long lever.[†] In some rare cases the inner end of the clavicle has been depressed, by a violent blow given to it.

"Whether the inner end of the luxated clavicle be on the outer or the inner side of the sternum, the acromion ought to be strongly pulled outwards and backwards, so that the displaced bone may be replaced; and in order to keep the acromion in that extended posture during the cure, a wedge-cushion is to be put into the arm-pit.

"The scapular extremity of the collar-bone has sometimes been misplaced and driven upwards, in consequence of a fall upon the shoulder. This case cannot readily be mistaken for a dislocated humerus, as the upper and fore part of the deltoid muscle is tense and flattened, and, therefore, there is an apparent distension at the top of the shoulder."

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[*] Such dislocations are comparatively rare. Sir A. Cooper has described the dislocation of the sternal extremity of the collar-bone forwards or backwards.

[†] The end of the collar-bone, when dislocated, has generally been thrown forwards, but sometimes upwards or backwards, and when so situated, according to Petit and Sir A. Cooper, by pressing upon the gullet, creates difficulty in deglutition.

Of Luxation of the Shoulder-joint.

" Dislocations of the shoulder-joint are much more frequent than those of any other joint, on account of the disproportional size of the head of the os humeri and the glenoid cavity, and the extent and thinness of the capsular ligament, especially at its inner and lower part: hence the head of the bone is frequently pushed inwards behind the lesser pectoral muscle, and that part of the greater pectoral which arises from the collar-bone, notwithstanding the support given by the muscles and tendons passing across the joint: and in proof of this it has been said, that if the arm be allowed to hang by the side, after these have been removed, the weight of the arm produces a subluxation; and, as a further proof of the influence of the muscles, palsy sometimes produces a similar effect.*

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* In my Elements of Anatomy, vol. i. I have described at length the appearances of such a dislocation, which presented themselves on dissection; and added, that " twenty-five years ago, my Father intended to publish his observations on dislocations, and got ten plates at that time engraved for the purpose; but unfortunately he did not fulfil his intention. Four of these engravings illustrate the nature of the most common kind of dislocation of the shoulder-joint.

The object of the first view, is, to shew the position of the head of the dislocated humerus, in respect to the great pectoral and deltoid muscles; the alteration in the form of the joint, occasioned by the displacement of the head of the bone; the angular appearance of the joint; the flattened appearance of the deltoid muscle, and its being lower than natural on the os humeri, and that the head of the os humeri is in the axilla.

In the second view, the great pectoral muscle has been removed, in order to shew the stretched biceps flexor cubiti and coraco-brachialis muscles, the relative situation of the displaced head of the bone in respect to the bloodvessels and nerves of the axilla, that the head of the bone presses on them, and had forced them backwards out of their na-

" On some occasions, the head of the bone passes downwards into the axilla: and, very rarely, the head of the humerus has been pushed backwards under the acromion, between the dorsum of the scapula, and infra spinatus muscle, forming a distinct prominence.

" The symptoms of the former are, acute pain and almost complete loss of power over the joint, combined with deformity of the joint.* In a dislocation into the axilla, the arm is brought with great difficulty to the side; it cannot be carried or raised so as to touch the head; and there is a hol-

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tural situation, and that the deltoid muscle has been displaced, together with the ball of the os humeri.

The third is a deeper view of the shoulder-joint. The coraco-brachialis muscle and shorter head of the biceps are seen crossing over the head of the dislocated bone. The tendons of the supra and infra spinatus muscles, and also that of the teres minor, are seen covered by condensed cellular substance. In this view, the musculo-cutaneous nerve is seen somewhat compressed by the head of the displaced bone; and, as the dislocation had existed for some time, there was no visible rent in the capsular ligament.

The fourth and last view was taken after the os humeri had been rolled outwards, and after opening a newly formed capsular ligament: there was a newly formed socket for the head of the bone; and in this instance, there was an exostosis within the newly formed socket. The head of the os humeri lay on the inferior costa of the scapula.

My Father, in his lectures, used to state, that the biceps muscle proves the principal obstacle to the reduction of this dislocation, and, therefore, always recommended the fore-arm to be bent, in order to relax the biceps, before an attempt is made to reduce the dislocation. Sir A. Cooper does the same; he observes,—" I generally bend the fore-arm nearly at right angles with the os humeri, *because it relaxes the biceps, and consequently diminishes its resistance.*"

Sir A. Cooper has (p. 422) published a very interesting account of the dissection of a shoulder-joint that had been dislocated; and informs us, that he had found the supra-spinatus muscle to be the *principal obstacle to the reduction of the dislocated humerus.*

* In some dislocations, the processes are remarkably prominent, and may be easily felt; as in dislocation of the elbow or shoulder joints. But at other times, as in the displacement of the head of the thigh-bone into the foramen ovale, the trochanter major is less perceptible than before the displacement.

low under the acromion of the injured arm.* The direction of the axis of the limb is altered, and, on bending the fore-arm and rolling the humerus, the head of the humerus may be felt in its new situation.†

"Whatever mode of reduction be adopted, the scapula should be fixed; but, unluckily, proper attention has not been paid to this, and no machine has as yet been proposed that answers this purpose well. I have often thought of having a machine made to lay hold of the inner half of the clavicle and the ridge on the dorsum of the scapula, and to have this fitted to a machine such as that of FREKE.

"Let the inner end of the clavicle and top of the ridge of the scapula be held fast by a very strong assistant, who should prevent his body from yielding, by planting one of his feet against a post, or other fixed substance; whilst his own shoulders are held fast by another assistant standing behind him, after which the fore-arm is to be bent to a right angle with the humerus, pressing at the same time the muscles which come from the scapula, and pass over the head of the humerus upwards, in order to relax them, and

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* Motion generally proves a cause of acute pain, and its intensity varies according to the nature of the injury; but it sometimes happens that the pain is not acute. Thus, if the head of the displaced bone rests on a muscle, it is dull. I met with an instance of dislocation of the head of the thigh bone upwards and backwards. This was so much so, that the patient frequently walked several miles in the course of the day; but when the head of the displaced humerus presses upon the axillary plexus of nerves, it causes pain, numbness, and sometimes partial paralysis of the arm.

† Sir A. COOPER has described a third kind of dislocation, which "is only partial, when the anterior portion of the capsular ligament is torn through, and the head of the bone is found resting against the coracoid process of the scapula on its outer side." There is a depression opposite to the back of the shoulder-joint, and the posterior half of the glenoid cavity is perceptible from the advance of the head of the bone. The axis of the arm is thrown inwards and forwards. The elevation of the arm is prevented by the head of the humerus striking against its coracoid process; and there is an evident protuberance formed by the bone in its new situation, which is felt readily to roll when the arm is rotated.

particularly the biceps flexor cubiti, where the tendon of its *long head passes over the head of the humerus.* By relaxing it, the os humeri will be more easily drawn downwards from the scapula; as its tendon, after its sheath has been torn, lies across the glenoid cavity, and is not relaxed, it will interrupt the reduction of the head of the humerus.

" If the head of the luxated humerus has got behind the pectoral muscles, which I have found it frequently does, the elbow ought next to be raised forward and carried inward towards the sternum, in order to relax the pectoral muscles, the coraco-brachialis and supra-spinatus muscle, which is best done by directing the patient to lay the tips of the fingers of the luxated arm over the top of the shoulder of the sound side.

" Let a strong laque, such as Mr Freke used with his ambe, be now fixed upon the lower end of the humerus above its condyles.

" The surgeon now directs the assistant who manages the scapula and clavicle to hold these as fast as possible; and the other assistants to increase the force of the extension by slow degrees. In the mean time, he lays hold of the upper end of the humerus; and, as soon as he finds it yield to the extending force, he should endeavour to elevate and direct the head of the humerus into its socket.

" The ambe of Hippocrates has been recommended; or, instead of it, a rolling pin has been put under the inner side of the neck of the humerus, for the purpose of elevating its head and directing it into its socket; or the patient has been directed to stand upon a chair, and then to pass his arm over one of the spokes of a ladder, that, by drawing away the chair, the weight of his body pressing the humerus against the spoke of the ladder, might force the head of the humerus upwards into its socket. But by such means, the humerus and the scapula are not sufficiently disengaged, which is necessary to the reduction. Instead of these methods, therefore, recourse is to be had to the common polyspart, or to the polyspart put into a box, that has connected with it a machine for fixing the scapula or trunk of the body, whilst we are extending the humerus, such as Petit the surgeon described; or, instead of these, we should take the machine of Freke, which combines the wheel and axis with the lever. If the resisting part of Freke's machine laid proper hold of the clavicle and scapula, I have no hesitation in saying that it would serve its purpose better than any other machine.

"One other method remains to be described, for the ground-work of which, we are indebted to the ingenuity of Mr White of Manchester. This consists in fixing a laque to the patient's wrist, and by means of a rope from this thrown over a pulley screwed into a beam in the roof of the room, raising the patient's whole body from the ground, so that the extension shall be made by the weight of the body. This general plan, I know, *from trial in several cases, to be excellent;* but it may be improved. By fixing the laque to the wrist, this joint, and that of the elbow also, are most improperly stretched and sprained. The tendon of the biceps flexor cubiti, instead of being relaxed, is extended across the glenoid cavity, and therefore its tendon renders the reduction very difficult or impracticable. Besides which, by raising the humerus to the patient's head, and nearly in a line with the patient's body, great violence is done to the luxated joint and its muscles; as, in most cases of the luxation of the humerus, the patient is not able to raise his arm so far as to lay his hand upon his head, and suffers great pain upon attempting to do so.

"Instead of Mr White's method, I would recommend the following, which has been practised with complete success in three remarkable cases. In the first case, the bone had been out three days, and its head was lodged behind the pectoral muscles, and all the common methods had been tried in vain. The bone had been out in the second case during four weeks; and in the third case, six weeks.

"In treating these cases, I directed a thick mattress to be spread upon the floor, on which the patient was laid horizontally on his back. His fore-arm was bent, the biceps and triceps were pressed upwards, and *the laque was fixed above the elbow*. A rope from this was thrown over a pulley fixed fast to a beam in the roof. The feet of the patient were supported by an assistant. His body was raised and let down again, repeatedly, by slight jerks, and to regulate these, a knot was made upon the rope, a little below the pulley.

"By these means, and with very little pain to the patient, the bones were readily disengaged, and reduced with little or almost no assistance from the hands of the surgeon."

Of the Luxation of the Elbow-joint.

"In consequence of the oblong shape of this hinge-joint, and strength of its lateral ligaments, the bones of the fore-arm are rarely luxated outwards or inwards in the adult. The lateral dislocation on the outer or inner side of the elbow-joint is invariably partial, owing to the great extent and irregularity of the articular surface.*

"Owing to the length of the olecranon, the depth of the pulley in which it plays, and the strength of the lateral ligaments, the olecranon cannot be luxated forwards. The bones of the fore-arm are generally dislocated backwards. The radius and ulna are situated on the back part of the humerus. The radius is behind the external condyle of the humerus; the coronoid process of the ulna occupies the back part of the trochlea of the humerus. The laceration of the capsular ligament is considerable on its anterior part. The biceps muscle is much stretched; but not to the same extent as the bracheus internus, and the triceps muscle, and all the muscles originating from the condyles of the os humeri, are much relaxed.

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* Sir A. Cooper observes, speaking of the lateral dislocation of the elbow-joint, "The radius forms a projection behind and on the outer side of the os humeri, so as to produce a hollow above it; the rotation of the head of the radius is distinctly felt by rolling the hand sometimes. The ulna is thrown upon the internal condyle of the os humeri, so as to produce an apparent hollow above it; the rotation of the head of the radius is distinctly felt by rolling the hand. Sometimes the ulna is thrown upon the internal condyle of the os humeri, but still it projects posteriorly as in the external dislocation, and then the head of the radius is placed in the posterior fossa of the humerus."

The luxation of the bones of the fore-arm backwards is most frequent. Sometimes the ulna alone, or radius alone, is dislocated in that direction, and sometimes there is congenital luxation of the radius. According to Dupuytren, the luxation of the radius forwards sometimes occurs.

"The luxation is consequent to a fall on the palm of the hand, the fore-arm being at the same time extended on the arm; the arm is shortened, there is deformity and swelling of the elbow, and the luxated fore-arm cannot be fully extended. Flection is impracticable, and rotation proves a cause of acute pain.

"The trochlea of the humerus, in lean persons, may be perceived projecting on the fore part of the dislocated elbow. Notwithstanding the swelling, the olecranon may be observed projecting more, and rising higher up upon the humerus, than in the sound arm. And, in the last place, the round head of the radius may be felt over the back part of the external condyle of the humerus. On rotating the arm, and on applying the point of the finger to it, and rolling the hand, the head of the radius is felt rolling on the point of your finger."

Of the Method of Reduction.

"A flannel-roller to be applied to the arm of the patient, who is seated on a chair, from the top of the humerus downwards to the insertion of the deltoid muscle.

"*The fore-arm is to be bent as nearly to a right angle with the humerus as can be done without giving much pain to the patient.* A strong person then lays hold of it, or let a laque be applied to it immediately below the insertion of the tendon of the biceps into the tubercle of the radius.

" Another assistant should lay hold of the fore-arm immediately above the wrist.

" Things being thus adjusted, let the first assistant keep the humerus fixed, whilst the second pulls the upper end of the fore-arm downwards and a little outwards, so as to disengage the coronoid process of the ulna from the trochlea of the humerus, and the radius from the back of the external condyle of the humerus.

" Let the second assistant, on whose management the reduction chiefly depends, and whose office therefore ought to be generally performed by the principal surgeon, as soon as he finds that the bones are disengaged, direct the third assistant, who has hold of the lower end of the fore-arm, to pull the fore-arm inwards towards himself.

" Upon the surgeon being sensible that the extension is sufficient, let him direct the fore-arm into its socket, which it will generally be easy to do.*

" After the reduction of luxation of the elbow, the fore-arm is to be kept bent, and one thick pasteboard is to be applied along the inner part of the humerus, and another along its outer part, and over the olecranon, supported by a bandage, in order to prevent the bones of the fore-arm from again starting off the humerus.

" The head of the radius is sometimes, though rarely, separated by a blow, from its connection with the ulna and with the external condyle of the humerus, and is to be felt on the anterior part of that condyle. I have seen one instance only of this luxation: it was occasioned, in a boy nine years of age, by a heavy weight, the pace of a day-clock, falling from the height of the second floor of a house upon the radius. A hollow may be felt below the end of the humerus, and there is a corresponding prominence on the back-part of the arm. I did not see my patient till three or four months had elapsed. It was impossible to reduce the radius. On performing pronation, after applying my hand to the elbow, I could feel distinctly the head of the radius rolling on the point of my finger.

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* If such dislocations be not reduced, the displaced articular surfaces are speedily adapted to each other, so that in a short time the motion of the joint is to a certain degree regained, and, what is remarkable, the olecranon becomes shorter.

" DESAULT was the first author who had most distinctly described dislocations of the lower end of the radius, which are sometimes consequent to violent action of the supinator and pronator muscles, or to external violence."

Of the Luxation of the Thumb and Fingers.[*]

" The dislocation is always backwards, and is readily distinguished, but with difficulty reduced.[†] Surgeons of experience have failed not only where the bones had been several days luxated, but even in recent luxations, because they did not disengage the bones by drawing them asunder, in opposite directions, before attempting to extend the joint, not aware, that in such joints as are moved, like a hinge, in two directions only, the lateral ligaments, which are thick and strong, may fall across the neck of the luxated bone, and render the reduction of its head very difficult.[‡]

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[*] Dislocation of the carpal extremity of the wrist, sometimes, though rarely, is consequent on a twist, in which case, supination cannot be performed, and the attempt to perform it causes acute pain. Both bones of the fore-arm have been displaced by falls on the palms of the hands, the hand being at the same time bended backwards. Two distinct projections, one formed by the ends of the radius and ulna, the other by the carpus, sufficiently point out the nature of the injury. On account of the extensive laceration of the ligaments, paste-board splints must be put on, and retained by a proper roller, in order to retain the displaced bones, which are very apt to be again dislocated.

[†] The arthrodial joints are rarely dislocated, on account of the slight degree of motion between their articular surfaces, and the number of strong ligaments connecting the bones. BOYER and Sir A. COOPER have met with the partial dislocation of the os magnum.

[‡] Mr LISTON states, that dislocation of the first joint of the thumb is not easily managed. The base of the first phalanx is displaced back-

" In one case of a recent luxation of the thumb on the back of its metacarpal bone, and in one such where the great toe had been luxated ten days, I found, by attending to the locking of the bones, and to their separation before the extension of the joint was attempted, that they were reduced by the hand, without the aid of ropes or machinery, with less than half the force of the extension which had been made in vain."

Of Luxations of the Hip-joint.

" These are much more rare than dislocations of the shoulder-joint, on account of the smaller proportional size of the head of the thigh-bone, greater depth of the acetabulum, greater shortness and thickness of the capsular ligament and the interarticular ligament, greater strength of the muscles and their tendons passing over this joint. Dislocation takes place only as a consequence of extreme violence when this joint is in a sound state ; but when the containing socket and articular cartilages are diseased, and pus is lodged within the acetabulum, by a very slight degree of violence, or even spontaneously, the head of the thigh-bone sometimes slips out from its socket, and this happens more frequently than at the shoulder-joint. The dislocation takes place in four different directions. 1*st*, The head of the thigh-bone is sometimes dislocated downward and forward, and lodged over the foramen thyroideum.*

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wards upon the distal extremity of the metacarpal bone, causing a remarkable prominence on the dorsal aspect, and a corresponding depression on the palmar. The thumb is shortened, deformed, and almost immoveable.

* After a bone has been displaced, there is a great degree of attrition between the articular surfaces ; hence a kind of bone, *not unlike to porcelain*, is sometimes deposited on the articular surfaces. This disease is very often observed in horses. Mr Dick, Professor of Veterinary Surgery, shewed me a number of such specimens. Whether this porcellanous substance be different in its chemical properties from the original bone, or merely the consolidation of the cells of the original bone, has not been determined. That such a porcellanous deposit

2*d*, The head of the thigh-bone sometimes passes upwards, and gets on the dorsum of the os innominatum, between it and the lesser glutei muscles. In the former, the luxated limb is elongated, the foramen thyroideum being lower than the acetabulum: the head of the thigh-bone may be felt in the upper and inner part of the thigh, and the limb is advanced forwards.

" The limb and toes are turned outwards, in consequence of the oblique situation of the foramen thyroideum, and the bringing the one limb to the other proves a source of pain. The knees are separated, and the great trochanter of course sinks inwards and backwards; and the body is bent toward the former by the contraction of the iliacus internus and psoas muscles. A cavity may be distinguished on making pressure over the acetabulum, and the head of the thigh-bone may be distinguished over the foramen thyroideum, on rotating the thigh-bone. On the other hand, if the head of the thigh-bone be luxated backwards the limb is shorter; the great trochanter is drawn forwards, the knee and foot are turned inwards, the hollowness of the acetabulum is perceptible, as the great trochanter has sunk inwards and been carried upwards and backwards; and, upon rolling the thigh-bone, its head is felt moving under the lesser glutei muscles.

" When the neck of the thigh-bone has been fractured, the limb becomes shorter, and the toes are everted. By slight extension, the limb is brought back to its usual length, and crepitation is heard during the rotatory motion; but no hollowness is felt at the acetabulum; the thigh-bone

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has taken place, may be known by its being consequent to the laceration or disease of one of the lateral ligaments of a joint, by which the articular surfaces of the bone are not steadily preserved in direct apposition to each other, by the swelling of the affected joint, and the pain felt on twisting it, but not when it is bent or extended, and by the cracking of the joint, which may be most distinctly heard on moving the joint. Remedies have no effect in removing this disease. There is also an increased secretion of synovia, which fills and distends the capsular ligament and bursæ in the vicinity of the diseased joint.

rolls easily; and the head of the thigh-bone is not felt moving under the lesser glutei muscles. By observing the following directions, the dislocation of the head of the thigh-bone into the foramen thyroideum, if not of long duration, may be reduced. Let the patient be laid upon his back on a bed, with the affected side of his pelvis over the beam at the side of the bed.

" Let a strong horse-girth with a buckle at one end of it be passed between his legs on the sound side of the pelvis, and nailed to the beam at the side of the bed, and at the other end of the strap passed through a buckle, so that the girth may be tightened at pleasure.

" The thigh-bone is to be bent towards the patient's body, till it forms nearly a right angle with it; or as far as can be done without creating much pain.*

" Let a strong assistant then lay hold of the crest of the os ilium and tuber of the ischium, and endeavour to fix these as much as possible. Let a broad belt or laque be now put around the upper part of the thigh; and another above the knee, and let each of these be given to the management of two strong assistants. Let another assistant take hold of the leg and bend it moderately. Let the surgeon now begin his operations, by directing the person who holds the leg to roll the knee outwards, in order to relax the tendon common to the psoas magnus and iliacus internus muscles, which is twisted around and inserted into the trochanter minor. Let him next direct the assistant, who holds the laque put round the top of the thigh, to pull it outwards, with the view of disengaging it from the foramen thyroideum. As soon as the head of the bone begins to yield, let the assistant who manages the laque fixed above the knee, pull the knee forwards.

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* Dr Monro secundus has observed: " It appears to me that a machine might be fixed to the frame of a bed, having its back part adapted to the tuberosities of the ossa ischia, and its fore part fitted to the anterior spinal processes of the ossa ilia, so as to fix the pelvis in its place, and prevent it from yielding during the extension of the thigh."

" The surgeon having now laid hold of the top of the thigh, and finding it moveable, directs it towards the acetabulum, and performs the reduction.

" Where the thigh-bone has been luxated backwards, the patient ought to be laid upon the sound side, that the weight of his body may not prevent the head of the bone from being brought to the acetabulum ; in other respects, the mode of reduction is similar, as in the former case.*

" I had, for many years, recommended the bending the thigh-bone, before an attempt is made to reduce it, and this method has been found successful."

Of the Luxation of the Patella.†

" This is sometimes consequent to the slipping of the foot whilst the knee is turned inwards, especially when the in-

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* 3*d*, The dislocation of the head of the thigh-bone upwards upon the ossa pubis, is more rare than either of the dislocations above mentioned. It has been described and delineated by Sir A. Cooper. The characteristic symptoms are, the eversion of the toes, the depression of the trochanter major (which is placed nearer than usual to the anterior and superior spinous process of the ilium), and the ball of the thigh-bone is distinctly felt in the groin. The femoral artery and vein are placed on the pubal side of the displaced head of the bone, and the crural nerves pass across it, which accounts for the palsy which sometimes accompanies this dislocation. In the 4*th* kind of displacement, the head of the thigh-bone lies over the sacro-iliac notch. This is of very rare occurrence, and is characterised by slight shortening of the limb, very considerable inversion of the toes, and by the head of the thigh-bone being perceptible under the gluteus maximus muscle. Besides, the head of thigh-bone has sometimes, though rarely, been dislocated downwards towards the tuberosity of the ischium, and sometimes upwards between the anterior and inferior spine of the ilium and ilio-pubal eminence.

† This dislocation, according to Sir A. Cooper, takes place upwards, outwards, and inwards. I have seen only the two first of these.

In some cases, the ligaments of the knee are so much relaxed, and dividual carries a load upon his shoulders. The patella is in danger of being luxated outwards, notwithstanding the greater height of the outer side of its trochlea of the thigh-bone; because the vastus externus is stronger than the vastus internus muscle, and besides this, by the bending of the knee inwards, a straight line, drawn from the origin of the rectus extensor to its insertion, passes on the outer side of the trochlea for the patella: so that this muscle likewise co-operates in occasioning the luxation.

"The reduction of the patella is commonly made without great difficulty, after bringing the leg into a straight line with the thigh, or placing it in the extended posture, and, at the same time, relaxing the rectus muscle by bending the trunk of the body forwards.

"But, in a case that occurred to me so far back as the year 1765, it was impossible to reduce the patella in the common way; and it was necessary, instead of attempting to pull the patella forwards, to press the outer side of it backwards, so as to make it roll on its axis in the contrary direction.

"As the capsular ligament of the knee, at the inner side of the patella, must be lacerated by the luxation, we ought, after its reduction, to guard against its relapse, as this may very readily happen.

"In 1761, I was consulted by Dr B., on account of a luxation of his knee-pan outwards, which had happened to him two years before that time, and which, after being reduced, had started repeatedly from its place. I proposed to him to apply a flat plate of iron, with a joint in its middle opposite to the joint of the knee, lined with a cushion, and tied to the lower part of the thigh and top of the leg. As he left this soon thereafter, and did not write to me, I do not know its effect.

"Some time after this, I was consulted by a gentleman

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elongated, that the knee-pan may be displaced by a very slight degree of violence, and may be readily reduced.

who had luxated his knee-pan outwards in a fox chace. I sent to his surgeon, the late Mr Summer, who had reduced it, a more simple machine than the former, which consisted of a thin plate of iron about six inches long and two inches broad, lined with a cushion, which was applied to the outer and lower part of the thigh, with its end projecting over the joint of the knee, and secured by a bandage; and this was found to answer its purpose so well, that the gentleman soon thereafter resumed his favourite amusement, trusting to the machine, and has had no return of the luxation."

Of the complete Luxation of the Knee.

"This is very rare.

"The joint of the knee is large in size, and in structure complex. Hence, it has been taken for granted by most authors, and especially by those who were not aware that in luxations the ligaments are generally lacerated, that the parts of the knee must, by a luxation, be so much injured, as to render a cure impracticable. This, however, is erroneous, as has been proved by cases having lately occurred, and particularly two in this place. One of these cases was treated by Dr Anderson of Leith, and the other by Mr Andrew Wood, surgeon in Edinburgh.

"In both, the tibia got behind and above the condyles of the femur; and in both, the luxation could neither be reduced, nor the bones kept in their place, but on bending the knee.

"Dr Anderson's patient, a few months after the accident, walked eighteen miles in one day; and Mr Wood's patient was intoxicated at the time of the dislocation, and his knee was completely luxated three times in the course of the following night; notwithstanding which, he was able to walk within doors, and probably his recovery would have been likewise very complete. Four months after the accident, the patient died of hydrothorax. On dissection, the laceration of the capsular ligament was found united, and nearly in a sound state; except that a bone, about the size of a common nut, was found where one of the oblique ligaments had been lacerated."[*]

Of the Luxation of the Ankle-Joint.

"The luxation of the ankle outwards or inwards is generally combined with a fracture of one of the malleoli[†] On account of the great strength of its lateral ligaments, the luxation backwards or forwards happens very rarely.[‡]

"This luxation may be readily distinguished by noticing the length of the heel. Nothing particular is to be observed as to the manner of reducing it, as the conical shape of the leg, and the size and situation of the foot, enable the surgeon to lay fast hold of the bones in the reduction of them."*

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[*] Boyer has also made mention of the rarity of complete dislocations of the knee-joint, and seems even to question the possibility of the accident.

Sir A. Cooper has described the complete dislocation, which is characterised by the limb being shorter, the projection of the condyles of the thigh bone, a depression in the situation of the ligament of the patella, and a bending of the leg forwards.

The tibia is also sometimes dislocated backwards by organic diseases; but the head of the tibia is very rarely dislocated forwards; and dislocation of that bone outwards or inwards are more frequent than the preceding. Mr Liston has observed, that subluxation of the bones of the leg is not unfrequent, from laceration of the internal lateral ligament.

The late Mr Hey, of Leeds, has described the partial dislocation of the semilunar cartilages of the knee-joint, which may happen with or without contusion. When this accident has happened, the ligament of the knee-pan seems somewhat relaxed, the leg may be readily bent and extended without creating pain; but the patient cannot, in walking, freely bend or extend his leg, and he is obliged to walk with the knee somewhat bent; and when the patient is sitting, the leg may be freely moved.

[†] It may be well worth while to mention, that in one such case, to which my Father was called by Dr Anderson of Leith, where the internal malleolus was fractured and the skin lacerated, followed by mortification, the whole of the astragalus was cast out, and its place so well filled up by a firm callus, that the patient could walk with tolerable ease.

[‡] Partial dislocation sometimes, according to Sir A. Cooper, takes place at this joint.

Of the Treatment after Luxations have been reduced.

"After reducing luxations, bandages and paste-board splints ought to be applied, more or less accurately, according to the structure of the joint, to prevent a return of the dislocation.

"After reducing the lower jaw, it will be sufficient to pass a strap under the jaw, and to pin the ends of it together at the top of the head, so as to prevent the patient from opening his mouth wide. After reducing the dislocated humerus, let the elbow be brought inwards and forwards, and laid upon the chest at the outer side of the mamma. Then let a thick and hard compress be laid on at the inner side of the acromion, and supported by a few turns of a spica bandage; after which the sleeve should be pinned to a waistcoat, and the fore-arm hung in a sling or scarf, and after reducing the dislocated elbow, and bending the fore-arm to a right angle with the humerus, a thick and long timber-splint ought to be laid on the outside of the humerus, and the lower end of it to pass beyond the end of the ulna or olecranon.

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* The foot has sometimes been dislocated forwards, by force applied to the foot or fore part of the leg whilst the limb is fixed. The symptoms are, elongation of the foot, combined with shortening of the heel. Luxation may also take place backwards, by which the foot is shortened and the heel elongated. In these cases one of the malleoli has been sometimes split. The reduction, which is sometimes very difficult, is made by pulling the foot whilst the leg is fixed, and making pressure backwards or forwards as the occasion demands.

The bones of the tarsus are so firmly wedged together, that it is impossible to disunite them without fracture.

Dupuytren has described two cases of congenital dislocation of the superior extremity of the radius backwards. A description and representation of this dislocation is given in vol ii. of the Cyclopædia of Anatomy, p. 76. London, 1839.

"The acetabulum for the thigh-bone is so deep that it will perhaps be sufficient to tie the patient's knees together; but it will be prudent to apply a thick compress on the inner side of the acetabulum, if the luxation has been inwards towards the foramen thyroideum, and to support this by a few turns of the spica bandage.

"After reducing the luxation of the knee, one strap is to be put around the middle part of the thigh, and another around the leg below its calf; and the two circulars are to have pieces of ribbon pinned to them, in order to keep the leg in the bent posture. A long and broad piece of thin pasteboard, moistened, ought likewise to be adapted to the back of the knee, and secured by a bandage.

"After reducing the ankle, a half-boot, slit open on its fore part, and its sides drawn together by a knitting, would serve to prevent the relapse of the luxation.

"Pieces of pasteboard, supported by bandage, could be easily applied, after reducing the bones of the hand or foot, so as to prevent a relapse."

By the different books of which my Father was the author, he acquired considerable fame; in consequence of which, without solicitation, he was elected a member of the different learned societies not only in Edinburgh, but also of the Royal Academy of Surgery of Paris, of the Royal Academies of Berlin, Madrid, Moscow, and Flushing.

It may not be improper to add in this place, that Dr Monro had intended to publish his lectures on Surgery, of which the subjoined Essays formed a part. For this purpose he had written out his lectures with care, and had preserved notes of all the remarkable cases which had fallen under his notice. He had drawings taken of the more remarkable, and had proceeded so far as to get at least 100 copperplates engraved. It is matter of regret, that, after having collected so large a store of very valuable materials, he did not publish the result.

I have not given place to private correspondence; it seems to me very questionable whether letters written in the confidence of private friendship should meet the public eye, excepting under very peculiar circumstances.

I have also avoided entering into the controversies which were so keenly maintained between Dr HUNTER, Mr HEWSON, and my Father. Such digressions seemed superfluous at this time. They may have had their use by rousing the energies of both parties; but now they are devoid of interest, and the sooner they are forgotten the better.

As an adjunct to the review of the different works of Dr MONRO secundus, it seems necessary to add a very brief notice regarding his Museum, which, in the year 1800, he presented to the University, together with a descriptive catalogue. The specimens in this Museum are numerous and highly illustrative of the anatomy of man, and of that of several of the inferior animals, in its sound and morbid states. Though Dr MONRO was in the habit of giving several lectures expressly on comparative anatomy, yet he preserved such specimens only, taken from the inferior animals, as are of very rare occurrence, or which require much leisure to prepare, because such quadrupeds, fishes, &c. as are required for lectures, may be had at any season in Edinburgh. Besides, Dr MONRO on all occasions demonstrated from recent dissections of the parts of the human body, and of the inferior animals; being convinced, that preparations which have been kept for years in spirits, or preserved by having been dried, communicate an imperfect and often erroneous idea of consistence, and relative situation and structure.

Since Dr MONRO's death, a great many specimens have been added to the Museum of the University, many of which are illustrative of organic derangements. For these the public are indebted to my colleagues of the Medical Faculty. It does not seem requisite to attempt to describe the contents of the Museum, as that has been done fully in the descriptive printed Catalogue which was published a few years ago.

With regard to Dr Monro's private character, a very general outline may suffice; for obvious reasons, little more can be expected from me.

Considering what Dr Monro had done, and had intended to do, it is evident that he had great zeal and love for his profession. He was ardent in the pursuit of knowledge, and made continued exertions to attain it. He was extremely economical in the arrangement of his time, and allotted to each hour its peculiar business; and he worked very nearly as hard towards the decline as at the outset of life. He was totally devoid of conceit, and, unlike many professors who have lectured for nearly half a century, did not remain satisfied with the lectures he had written at the beginning of his career. On the contrary, he was in the constant habit of altering and improving his lectures. He also took an active share in every important discovery pertaining to his profession, and made his experiments on Galvanism, when far advanced in life. He was also peculiarly interested by the discoveries of Dr Jenner: he inoculated with his own hand many children with the vaccine matter, and watched the progress of the disease with the greatest care. He remarked the difficulty of distinguishing between perfect and imperfect vaccination, and was therefore very much delighted by the discovery of Mr Bryce, whose simple test, consisting in inserting the cow-pox matter into the right arm two or three days after it had been introduced into the left, and observing whether the pustules on both arms arrived at maturity at the same period of time, he considered infallible. It is not a little remarkable, that Dr Monro had arrived at the conclusion *as to the identity of human cow-pox and small-pox*, a very remarkable fact, lately confirmed by the ingenious and decisive experiments and observations of Mr Ceely, which prove the identity as to the origin of small-pox and cow-pox, the latter being small-pox communicated to the cow.

Mr Ceely inoculated cows with small-pox matter. The vesicle produced in the animal had every appearance of the vaccine pock; in proof of which, children were inoculated with matter taken from the cow thus artificially infected, *and the result was a genuine vaccine vesicle.*

The fact was satisfactorily established. These children were submitted to small-pox inoculation, and *were found to be protected from the disease. The importance of this discovery cannot be too highly appreciated. It is only necessary (where, from any circumstances, good vaccine matter cannot be obtained) to inoculate a cow with common small-pox, and this virulent morbid poison, so fatal to human life, will be converted, by this useful animal, into a mild fluid, capable of protecting all inoculated with it from small-pox.*

Dr Monro was of a very cheerful turn of mind, and fond of society, to the hilarity of which he most essentially contributed by the numerous anecdotes, which he took great delight in communicating.

He lived at a time when the literature of Scotland had been raised to a high pitch of eminence by his contemporaries, Principal Robertson, the Rev. Dr Blair, Lord Kames, David Hume, Adam Smith, Henry Mackenzie, Professors Cullen, Black, the Gregorys, the Rutherfords, Home, Hope, Hutton, Robison, Dugald Stewart, Playfair, and the Rev. A. Alison, and J. Home; with all of whom he lived in habits of intimacy.

Though Dr Monro necessarily spent the greater part of his life in Edinburgh, he was not insensible to the charms of the country. His success in his profession enabled him to gratify his favourite object, by purchasing a small estate in the vicinity of Edinburgh, which he took great delight in ornamenting.

Dr Monro was a kind husband, and indulgent parent:

and his good offices were not limited to his own family and relations. He was always ready to assist the poor with his purse and professional skill; was a subscriber to all the charitable institutions; and took an active share in the management of the Royal Infirmary.

In person, Dr MONRO secundus was about the middle stature, and of vigorous and athletic form. His shoulders were high, and his neck short; his head was large, and his forehead full. His features were strongly marked. He had a prominent nose; projecting eyebrows; light blue eyes; rather a large mouth; and a countenance expressive of much intelligence and study.

During his long life, several portraits were taken of him. That of Mr KAY, who has represented him walking along the North Bridge in a black dress and cocked hat, conveys a very distinct impression of his face and figure.

A portrait of him, when a young man, was also taken by Mr SETON, which has been esteemed a good likeness.

The late Sir H. RAEBURN painted the portrait from which Mr J. HEATH engraved the annexed portrait, which is, in my mind, a strong likeness.

When my Father had reached his eightieth year, he used to become very drowsy after dinner. He had also occasional headach and slight bleeding at the nose. These symptoms were the preludes to an apoplectic seizure, from which, by the unceasing attention of his friends Dr RUTHERFORD and Mr BRYCE, he somewhat recovered. But the malady was not eradicated; his weakness gradually increased; and, after the lapse of four years, he died, without suffering, on the 2d of October 1817, in the eighty-fifth year of his age.

POSTSCRIPT.

Professor Dieffenbach, of Berlin,* removes dislocations of one or two years' standing, by the division of the muscles in the neighbourhood of the dislocation. He has published a case, in which a dislocation of the humerus, of two years' standing, was reduced in this way.†

It is obvious that such a mode of treatment is applicable only to those cases in which the muscles around the dislocated joint are healthy, and not united by adhesive inflammation; whilst, at the same time, the glenoid cavity, or acetabulum, retains its usual size and form, which seldom happens. I have a specimen, in which the thigh-bone had been dislocated upwards and backwards. A deep socket of bone was formed upon the back of the os innominatum, whilst the acetabulum is not above one-third of its usual size and depth. The same remarks apply also to the shoulder-joint. It is scarcely to be expected that by replacing the dislocated head of the bone, the original socket would regard its former size and shape.

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* See Foreign and British Medical Review, April 1840, p. 555.

† Dr Guerin has observed (Gaz. Med. de Paris, No. iv. 1840) that congenital luxations and pseudo-luxations of joints depend, in the majority of cases, on primitive muscular contraction, which takes place in three different modes, by shortening, palsy, and by stoppage of development of the retracted muscles; and the different varieties of these deformities are like those of the neck, the spine, the foot, the effect of this retraction being differently distributed in the muscles of these parts. In a girl, aged 14 years, I divided the biceps, semitendinosus, semimembranosus, and vastus internus, for two incomplete luxations of the knee, produced by primitive retraction of these muscles; on each side, there was a subluxation of the tibia backwards upon the condyles of the femur rotation of the limb outwards, through the space of about one-fourth of a circle, and an inclination of the leg upon the thigh of about sixty degrees on the day after the operation, by the flexion of the leg on the thigh, the rotation outwards, the lateral inclination and gliding backwards of the tibiæ were removed.

EXPLANATION OF PLATES.

PLATE I.

This is the uppermost part of the original Plate 10th, published by my Father, in his book on the Nervous System, in the year 1783, which he has described as follows:

This table represents a fore view of the Spinal Marrow of a man, after cutting away the bodies of the Vertebræ, laying open the sheaths formed by the Dura Mater and Arachnoid coat, and cutting the anterior bundles of the Spinal Nerves.

A B, The sides of the Atlas.

C D E F, The sheaths formed by the Dura Mater and Arachnoid Coat, laid open.

I I, Represents the Cervical Nerves.

M, A partition between the holes in the Dura Mater for the passage of the anterior and posterior bundles of fibres which compose each of the nerves of the Spinal Marrow.

N, The anterior bundle, in its proper hole, covered by a sheath of the Dura Mater, which covers the Spinal Marrow.

O The posterior bundle with its proper hole and sheath.

P, A ganglion in the posterior bundle.

Q, The anterior bundle joined to the Nerves which issue from the ganglion of the posterior bundle.

a b c, The Ligamentum Denticulatum, fixed by filaments to the Pia Mater, proper to the Spinal Cord.

FIG. 2. Shews more fully than in the former figure, the way in which the accessory nerve is connected with the Spinal Marrow, and with the posterior part of the Spinal Nerve.

PLATE II.

Gives a view of the Lateral Ventricles, of the 5th Ventricle, and also of the 4th.

a a, Hemispheres of the Brain.

c, The anterior cornu of the Lateral Ventricle.

d, The posterior cornu of the Lateral Ventricle.

e f, The distended portions of the Lateral Ventricle.

g h, The Corpora Striata. *c*, The anterior part of the 5th Ventricle much enlarged. *o*, The 4th Ventricle laid open. The case from which this engraving was taken is described at page 17 of my Morbid Anatomy of the Brain.

PLATE III.

This Plate gives a view of the Lactiferous Ducts of the Mamma of a young woman, who died a short time after she had suckled her child, Very beautiful representations of these ducts have been lately published by Sir ASTLEY COOPER. This plate was originally published in my Elements of Anatomy. Edinburgh, 1831.

PLATE IV.

This Plate was published by my Father in his book on the Structure and Functions of the Nervous System, Edinburgh, 1783.

A, Fig. 1. represents the Ridge of the Nose.

C, The left Antrum Maxillare cut open.

F G, The ends of a bristle passed between the membrane which lines the left side of the Nose, above the upper part of the Os Spongiosum Superius (from which the bone has been cut off) and the branches of the Olfactory Nerves. These branches join, and separate again, repeatedly; forming an elegant network on the outside of the membrane, or between it and the bones.

H, The Nasal branch of the first branch of the 5th pair of Nerves, ending partly in the Septum Narium, and partly on the membrane which lines the outer side of the Nose.

I, The Nasal branch of the second part of the fifth pair of Nerves.

Fig. 2. This figure represents part of the network formed on the outer side of the Membrane of the Nose by the branches of the Olfactory Nerve, viewed with a magnifying glass.

Fig. 3 represents a principal part of the Nasal Branch of the first branch of the 5th pair, ending on the Septum Narium.

PLATE V.

The two figures in this plate represent the posterior part of the human iris. Fig. 1st shews it of its natural size, and fig. 2d represents it magnified.

AA The inner side of the anterior part of the choroid coat.

BB The ciliary processes.
CC The vessels and radiated fibres.
DD The sphincter of the iris.
E The pupil.

Plate VI.

The different figures of this plate afford a striking illustration of the diversity of form of the human Skull in different nations, and in individuals of the same nation.

Fig. 1st represents the skeleton of a native of Australia, who was between twenty and thirty years old. The bones are very peculiar in many respects. The cranial part of the skull is small in proportion to the bones of the face; the head is short from before to behind, and narrow, notwithstanding the remarkable projection from the occipital bone; but it does not seem as if it had been compressed laterally.

The frontal sinuses are large, very prominent, and overhang the orbits in a striking manner; giving, indeed, a very peculiar, and, I should say, characteristic, appearance to the skull. The sides of the skull are flat, and the temporal fossæ are deep, but not so much so as in the negro.

The upper and under jaws are much imprinted by the muscles; the former is more prominent in the European, but much less so than in the Negro; but the under jaw projects, instead of retreating, at its mental portion.

The orbits are somewhat of an oblong square form, and broader from side to side than in a vertical direction.

The ossa nasi are short and flat.

The cavity for the nose, and the ossa turbinata, are larger than in the European; and the form of the bottom of the nose is quite peculiar to this nation and the natives of Van Diemen's Land; for, instead of being flat, it slopes downward and forward. This race of people possess a very acute sense of smell, which is probably to be imputed to the large size of the nasal cavity.

The teeth are large, but not so prominent as in the negro.

The palatine arch of the superior maxillary bone is longer and deeper than in any other skulls I have seen, excepting in those from Van Diemen's Land.

All the foramina for the bloodvessels or nerves at the base of the skull are larger than in the European.

This engraving was taken from a very faithful drawing of the late Mr Geikie.

Fig. 2d represents the skull of a native of the banks of the river Colombia, which had been elongated by pressure, artificially applied.

The drawing was made by my friend and pupil Mr George Bell.

Fig. 3d represents very faithfully the profile of an African skull.

The distinctive characters of the negro skull are, the small size of the cranial part of the bone, in its longitudinal and transverse direction; the retreating forehead, which is also narrow; the flatness of the sides of the head; the large size of the temporal fossæ; and the large size of the temporal ridges of the frontal bone, which are sometimes serrated. The parietal bones are smaller, and the impressions made by the temporal muscles are nearer to each other, than in the European and retreating chin.

The occipital bone is flatter. The temporal bones are less, and the squamous sutures are not so much arched. Other characters consist in the great size, thickness, and prominence of the bones of the face, which seem to have been impressed by large muscles; the prominence of the alveolar processes, and consequent obliquity of the facial line; the oblique direction of the large incisor teeth; the great breadth and height of the zygomatic processes, indicating the large size of the temporal muscle; the retreating chin; the great size of the cavity of the nose; and the foramen magnum ossis occipitis being larger, and placed further back than in the European skull.

The African skull is still farther marked by greater size and thickness of the under jaw-bone, and the greater size and breadth of the teeth, which are more solid and hard. This is, perhaps, the cause why the Negro is not so liable as the European to caries of the teeth. The facial angle is between 60° and 70°.

The drawing was taken by Mr Clift, keeper of the Museum belonging to the Royal College of Surgeons of London.

Fig. 4th represents the profile of a red Indian. The original is in the Museum of Natural History of the University. The drawing was taken by that distinguished artist Mr Thomas Duncan.

Fig. 5th was copied by Mr Bewick from a cast of a skull of King Robert the Bruce.

The cast was taken when the tomb of that distinguished Monarch was opened at Dumferline in the year 1819.

The bones were in a state of high preservation, but very brittle. The skull was of a reddish-brown colour, and very irregular as to its surface. When viewed in profile, the prominences of the frontal sinuses are very conspicuous, above which, the forehead inclines backwards as far as the junction of the frontal and parietal bones. Over the sagittal suture, there is a distinct ridge in the skull, which is slightly arched; and, towards the back part of that suture, the skull slopes suddenly downwards and backwards in an oblique direction.

The occipital bone is remarkably convex outwardly, and strongly marked. The temporal fossæ are deep, and much impressed by the fasciculi of the temporal muscles. The centres of ossification of the parietal bones are prominent. The bones of the face are large, and deeply impressed by the muscles. The zygomatic arches were broad, and also high: so that there is every reason to suppose the temporal muscles had been large and strong. The impressions made by the masseter muscles on the under jaw were unusually deep. The breadth from one cheek-bone to the other is equal to five inches. The distance from the most prominent part of the occiput to the meatus auditorius externus is about one inch greater than the distance from the meatus auditorius externus to the most prominent part of the upper jaw-bone. The under-jaw is strong, and of a square form; and, when viewed in profile, there is a distinct prominence of the chin. A line drawn downwards from the frontal sinuses, along the bones of the face to the alveolar processes of the under jaw-bone is nearly vertical. The angle which the ascending processes of the under jaw forms with the body of that bone, is nearly a right angle.

Fig. 6th was copied, at my request, by that very celebrated artist Mr HAYDON, from a cast of the head of Sir WALTER SCOTT, taken when he was in Paris.

The print gives a very correct view, in profile, of the form of the head of that great man. The diversity in the form and proportions of the head in figs. 5 and 6 is very remarkable.

PLATE VII.

This plate is intended to represent the state in which the arch of the aorta is found in many cases of aneurism. Very different opinions have been held regarding the state of an aneurismatical artery. (*Vide* Memoir, p. 7.)

In this case there is a general dilatation of all the coats of a part of the arch of the aorta, but it is evident that there had been, at the place where the artery burst, an expansion of the outermost coat, and a rupture of the middle and innermost coat. The patient, a man, æt. 34, had laboured under a sense of constriction in his chest, difficult breathing, palpitation, irregularity, and intermission of pulse, which sometimes sank so low as to beat only 46 times in the minute, and he could not bear the horizontal position. When at the water-closet, was suddenly seized with acute pain in the region of the heart, which he said, he felt crack, and died in a few minutes, and to appearance from suffocation.

ESSAY I.

OF THE LYMPHATIC SYSTEM.*

Dr Monro's opinions as to the lymphatic system were so novel, and so pregnant with interest, that they attracted

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* That Dr Meckel has no claim to the discovery of the structure of the lacteal glands, is obvious from the following extract of a letter from Walther, the assistant of Dr Meckel :—

"Anno 1756, sub finem Novembris, prima vice vasa lactea mesenterii, et earum progressum per glandulas conglobatas, vidi quasque mecum vidit, et elegantem structuram glandularum conglobatarum admiratus fuit Meckelius, quarum structuram *ante te* Meckelius neque novit, neque per injectiones a se institutas demonstravit."

I apprehend there is strong evidence in favour of my father's claim to this discovery.

"The only evidence necessary to be adduced is the letter of the celebrated Dr Black, which gives a very luminous and short exposition of the facts upon which his opinion is built.

"*Copy of a Letter from Dr Black, Physician, and Professor of Medicine at Glasgow, to Dr Alexander Monro jun.*

Glasgow, 24*th March* 1758.

"Sir,—In answer to your letter, in which you require of me to declare what I remember of an Essay of yours, which you allowed me to read before you left Scotland, I can freely declare that I read that Essay in September 1755; that the whole substance and design of it were, in every material point, the same with those of the Dissertation you have since published at Berlin.

"The design of it was, to propose and support a new opinion, with respect to the origin and use of the lymphatic veins, which was, *that they are a distinct system of vessels, having no immediate connection with the arteries and veins*, but arising, in small branches, from all the cavities and cells of the body, into which fluids are thrown ; *and that their use is to ab-*

great notice in every part of Europe, and more especially that of Dr **Meckel** at Berlin, and of Dr W. **Hunter**; both

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sorb the whole, or the thinner parts, of these fluids, and restore them to the mass of circulating humours.

"Your Essay contained an ample review of the opinions of different authors upon the same subject, and an examination of the experiments and observations from which such opinions have been deduced; in which you endeavoured to shew, that these experiments and observations were, in fact, unfavourable to the common opinion, and tended to support that which you offered. You likewise observed, that the singular structure of these vessels, and their disposition in different parts of the body, were such as particularly adapted them to perform the office of absorbents. And you added some experiments of your own, which pointed out their use to be of this kind, and were very unfavourable to the common opinion. I remember, likewise, that you had, for some time, been busily employed in anatomical experiments upon this subject, and shewed several preparations, which furnished arguments in support of your opinion. You had thrown quicksilver into the arteries, with such force as to produce extravasations, and from these the lymphatics were filled, either by the weight of the quicksilver in the arteries, or by a gentle agitation and alternate compression of the parts in which the extravasations were formed. You told me, at the same time, that an easy method of exhibiting the lymphatics, is, to fill the cells of the conglobate glands with air, which passes freely into such lymphatics as rise from them, to take course towards the lacteal sac.

"But the proofs which gave me the greatest pleasure and conviction, *were those deduced from some phenomena occurring in the practice of medicine, in which it is often observed that where acrid matter is applied to the pores of the skin, or has access to the cells of the cellular membrane, as in the case of an ulcer, the neighbouring conglobate glands, which are between the parts affected and the centre of the body, are disordered with swelling and pain; manifestly from the matters being absorbed singly, or mostly by the lymphatics, and its being collected and allowed to stagnate, for some time, in the cells of these glands, into which the lymphatics empty themselves, and by its stimulus producing the disorder which follows.* The instances which you gave of this kind were, I think, nearly or altogether the same with those adduced in your late Dissertation.

"The case of a blister applied to the head, and the instance of buboes in the venereal disease, are still fresh in my memory.

"I think I likewise remember the observations on inoculated patients; though I cannot be positive with respect to this or the other examples you have made use of. Upon the whole, your Latin Dissertation seems to me to contain the same matter, and that treated in the same manner, as the Essay I read in the year 1755. And, though you may have, no doubt, improved upon that Essay in your Dissertation, I of whom endeavoured to establish a priority of claim to them. The claim of Mr HEWSON to the discovery of the Lymphatic and Lacteal System of fishes, birds, and amphibious animals is considered and refuted at considerable length by Dr MONRO secundus, in Chapter VII. of his book on the Structure and Physiology of Fishes, Edinburgh, 1785.

EXTRACT FROM LECTURE XLVI.*

Is it more correct to adopt the supposition, that the small valvular lymphatic vessels, which are largely distributed over the whole body, constitute a part of the vascular system, and form continuous canals with the smaller ramifica-

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must confess, I received as clear an idea of your doctrine, and as full a conviction of its truth, from that Essay, as I have received since.

"I am, Sir, your obedient humble servant, JOSEPH BLACK."

Dr MONRO secundus, also was the author of the doctrine of the absorption of bones, and the other solid parts of the body.

He made mention of this doctrine in his lectures, according to his statement, since the year 1759; whereas, according to Sir E. HOME, 'Mr JOHN HUNTER's Observations on the Growth of Bones have been mentioned in his lectures only since the year 1772,—the first year in which he gave lectures.'

Upon the above principle, my Father endeavoured to explain the disappearance of the upper part of the breast-bone in cases of aneurism of the arch of the aorta, which Dr WILLIAM HUNTER imputed to a solvent power of the blood: 'But in this case,' (he has observed) 'the appearance was rather as if the blood had insensibly dissolved, and washed away the substance of the bone, making greatest havoc in the softest part of the bone, as we see in stones of unequal texture that have been long washed by a dropping, or a stream of water. Has the blood that property, which some have ascribed to it, of dissolving bony matter?'

It is plain, then, either that Mr JOHN HUNTER had not, at that time, proposed the doctrine of the Absorption of Osseous Matter; or, if he did so, that his brother was ignorant of it, or paid no regard to it.

Vide also Thesis of Dr WINTERBOTTOM de Vasis absorbent. (Edinburgh 1781), which affords strong and additional evidence on the same side.

* This extract is taken from a manuscript copy of lectures written by Mr THORBURN during Session 1773-4.

tions of the arteries, or that they form a distinct and separate system of vessels, which are subservient to the absorption not only of the fluid, but also of the solid parts of the body? To me, the more simple and probable opinion is, viz., as we have seen that an artery at its extremities divides into red and colourless branches, might it not be supposed that the red veins, in like manner, are formed of coloured and colourless branches, and that both join together to form the red veins, and that they thus correspond with the arteries in one of their principal offices of carrying on the circulation, and in that only; whilst the lymphatic vessels correspond with them, in so far as they perform the function of absorption, taking up all the liquors that are any where effused; so that the circulation is carried on by the red veins, and absorption by the valvular lymphatic vessels, and that these have open mouths, beginning from the surface and from all the cavities of the body, so that the fluids do not pass directly into them by the force of the heart. Let us endeavour, from facts and experiments chiefly, or by additional arguments from the nature of things, to establish a fixed opinion. And the first thing necessary to enter upon, is, to shew that authors have not, as they suppose, given an absolute and direct proof that the valvular lymphatic vessels proceed from the arteries; the arguments used for this purpose, though at first sight plausible, and seemingly conclusive, turn out, after proper examination, to be founded in error. As we observe the blood out of the body to divide into a red and colourless part, and as we find in the body coloured and colourless veins, there can be little doubt, that each of the veins corresponds to the parts of the different colours; but surely this observation touches not the origin of the veins; we from thence conclude nothing with regard to that, from there being in the body parts that are colourless. We may conclude, that the arteries divide into coloured and colourless branches, or we get a proof, that there are more arteries than we perceive with the microscope, the colourless branches escaping us from their smallness, and the want of globules, so that we have no manner of judging; just as if water was running in a glass-tube placed across this room, it is next to impossible to determine whether the water was at rest or in motion.

The next argument is more direct. We have been told, and told truly, that, when an injection is thrown with force into an artery, the injected matter is found to fill the valvular lymphatics, and I shewed you lymphatics filled from the spermatic artery. But several circumstances have been overlooked by Cowper and Nuck, the chief authors of such experiments, and from whom most of the others have copied. There is a mystery in Cowper's Experiments; he particularly insists upon those made on the spermatic cord, that he repeatedly poured quicksilver in, and filled the lymphatics, but he could never make it pass into the corresponding spermatic veins; so if there is nothing farther here than what is mentioned, how comes it that the red globules do not pass through these, and leave the red veins? In like manner, look into Nuck, where he speaks of injecting the spleen from the splenic artery; he filled the lymphatics, but not the red veins; he mentions, at the same time, that *he observed vesiculæ, and lymphatics coming out of these*, &c., so that there was a laceration of the tender branches of the artery, an effusion into the cellular substance, and a laceration of the branches of the lymphatic vessels, at which the mercury had entered, which I have found repeatedly to happen, and without laceration, it never succeeds; but if we fill the veins at the same time as the arteries, the lymphatics are not filled; whereas, upon pushing an injection suddenly, though composed of materials not of the most penetrating kind, the lymphatics are injected, and not a drop passes into the veins, particularly those of the testicle. I have filled many of the lymphatics, some of them very small; the valves prevented me from filling them by their trunks, and none of the bloodvessels have the matter injected into them. The manner of injecting them, was to bruise the substance, to pour the mercury into a hole, and to work it into several branches of the lymphatics. Such experiments do not prove that the lymphatics are continued from the bloodvessels, for I do not mean to hint that the mercury passed in at the most minute mouths of the lymphatics.*

There is another argument of considerable weight, that the lymph is sometimes coloured with the red parts of the blood. This observation likewise is just, and what I have seen repeatedly, fifty different times, in living animals; nay, constantly it is the case, wherever, by a wound made upon a living animal, the blood is effused, or the finer parts of it a bloody water, whether into the cellular substance or larger cavities of the body; but more especially, if by the wound sensible parts have been exposed to the air so as to become inflamed, and it matters not which of the bowels are exposed to produce this effect of tinging the lymph red. Now, what reason is there for such an appearance? Are we to imagine that, when the red colour is found, where perhaps red globules are found in the lymphatic vessels, that the whole arterial system has been dilated so as to allow these to pass through? Only attend to some of the instances; there was nothing beforehand to produce the dilatation, which must have taken some time, as from the inflammation continuing; but in the instances adduced by WEPFER, for example, violent vomiting was produced by poisoning the animal, a red colour was found in the lymph, and the blood was found extravasated at the root of the mesentery. One of two things happens here, viz. either from some sudden violence or wound, the branches of the lymphatic vessels are lacerated, and the blood enters in a mechanical manner from the cut arteries, as injected matters enter after death, or in an inflammation the red part of the blood is effused. I mentioned the appearances consequent to every inflammation ; a bloody matter is effused into the cellular substance, and this circumstance was not attended to by those who drew the conclusion that the red colour shewed the continuation of vessels ; and they overlooked this circumstance, that the red globules break down into invisible parts, so are perhaps as capable of being absorbed by the sound mouths of the lymphatics as any of the other parts,—nay, more readily perhaps, because, where the whole mass is effused, the red colour disappears before the yellow. Instead, therefore, of this observation proving *a continuation of the valvular lymphatic vessels with the arteries*, it rather seems to shew the contrary, *that the lymphatics begin by open mouths from these cells, into which, in cases of inflammation and wounds, the red particles are effused.*[*]

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* The later observations of MASCAGNI lead to the same conclusion.

There is no proof of the colourless arteries terminating in the lymphatic vessels ; but do we find any that the colourless arteries do not terminate in red veins ? I apprehend that it is very much otherways ; every circumstance leads to the supposition that they do. Let us first take the analogy of the arteries. An artery, at its termination, consists of coloured and colourless branches. Why should we not suppose a vein to consist of the same? We surely admit that no more of the colourless part of the blood is formed than is proper for the purposes of life, for maintaining the diffusion and separation of the red globules from each other, and for many other uses. Now, if these parts be necessary, where the fluidity is preserved by the greater agitation of the heart and arteries, they are certainly more so, where the circulation is more languid; and, therefore, that, after the necessary secretions are made, the remainder should return to be added again to the red globules. Instead, therefore, of imagining that this part is carried away from the red veins, we must suppose that, after the colourless arteries have made their dispersion through a colourless organ, they run into red veins. Thus, in the eye of a child, there are arteries conveying red blood, which afterwards become too small to admit the globules, yet the termination of these arteries must still be in the red veins: and in the different classes of animals, in which the lymphatic system is found, and where there is a greater proportion of colourless fluid, as in a skate, the flesh is of a white colour, so that the arteries must exclude the red globules; and if the colourless veins terminated in the lymphatic system, we would find the lymphatics of a prodigious number and size, and the vena cava receiving only the red globules very small in proportion to the aorta, but the proportions are the same as in man. We may, therefore, apply what we observe in these fishes to ourselves, and take it for granted that the red veins correspond to the red arteries, so far as concerns the circulation of the blood. And if we prove that the red veins receive all the circulating branches of the arteries, we leave absorption only as the office of the lymphatic system. The proofs of absorption by the valvular lymphatic vessels are direct. These vessels begin by open mouths at the several cavities, and suck in at their extremities the liquors they convey. The analogy of the lacteal vessels shews this: we find the same structure of their coats, which are thin, tough, and transparent; we find them both crowded with valves; both pass through glands similar in structure, shape, colour, or consistence:—thus the mesenteric glands and the conglobate glands of the groin and axilla perfectly agree in every circumstance. We find the vessels in a similar way passing along the surface, and passing through them; and, to carry on the analogy, they unite together, so that the thoracic duct is common to both systems. Surely what we observe of their structure and course, leads us to suppose, that they agreed as to the manner of their origin; or that the lymphatic vessels begin in the other parts of the body by open mouths, whether on the surface or from the different parts of the cellular substance, from the several cavities of the thorax, abdomen, head, joints, and universally. Or, let us make the comparison with the red veins; if the lymphatics and red veins had a similar origin, we should probably find the valves disposed nearly in the same manner. We find valves in the red veins only where there are muscles, because their single purpose is to direct the blood to the heart. But, in the lymphatic vessels, the valves are found every where,* and the effect of this is, that the slightest pressure on them drives the fluids onwards beyond the next set of valves, towards the heart. Thus, if we inject a lymphatic vessel with mercury, we must be cautious how we touch it, for it readily goes onwards, and we cannot again fill the interstices between the valves that the mercury has left; so they are fitted to take advantage of the slightest pressure, or impulse; every stroke of an artery passing over them serves to drive the blood onwards. Hence universally, the lymphatic system is crowded with valves, shewing that it wants the same pressure onwards, or that *vis a tergo* which is found in the other veins; so that they are fitted to take the advantage of pressure, which is necessary to the progress of their contents.

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[*] A diversity of opinion now-a-days prevails as to the mode of origin of the lymphatic vessels. 1*st*, They have been described as beginning by a network of vessels of different diameters. The orifices of the lymphatic vessels of the skin of fishes are obvious by injecting them from the large plexus of lymphatic vessels connected with the greater curvature of the stomach, as these vessels are destitute of valves, and may be injected like an artery. (*Vide* MONRO on Fishes). 2*d*, The lymphatics have been supposed to take their rise from small cells. FOHMANN thought he had seen such an origin in the umbilical cord, and cornea of the eye. The author of this note has not had an opportunity of examining the preparations of the lymphatic vessels made by FOHMANN : he has been informed by his son, who has seen them, and who, like MULLER, observed, "it is doubtful if every thing that is shewn by injection consists of lymphatic vessels." 3*d*, The lacteal vessels begin by short radiated tubes from the villi of the intestines. (Physiology translated, p. 265). MULLER affirms the villi are not perforated at their extremity, as LIEBERKUHN, CRUICKSHANK, HEDWIG, and BLEULAND, supposed.

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* Excepting in their very minute branches in men, in fishes, and in amphibia.

Further, *after an artery is tied up, and the flow from the heart intercepted, the lymphatics continue to be filled.* Why? Because they are independent of the artery, and whilst the life, the warmth, sensibility, and contraction of the parts continue, the motion in the lymphatic continues, though *vis a tergo* has entirely ceased. Nay, after the heart is cut out, and the thorax or abdomen laid open, if you empty any vessel by pressure upon it with the finger, it soon fills again, after the motion has ceased in a remarkable degree in the red veins.*

The same thing appears from the colour and appearance of their contents. I shall have occasion to insist upon the cause and manner in which jaundice is produced. I would only, at present, mention as a fact, that, in jaundice occasioned by a total obstruction of the biliary ducts, I know for certain that the lymphatic vessels take up the bile almost as pure and bitter as it is found in the gall-bladder. I have seen myself the lymphatics filled in that manner,† and shewed them to Drs YOUNG and BLACK, who were not contented with seeing the colour, but, opening the lymphatic, they tasted the bile, and found it to be as bitter as when it is taken from the gall-bladder. This is a direct proof *that the lymphatic vessels in the liver begin from the cavities* of the biliary duct, *i. e.* perform absorption, and, so far as proof is necessary, this may be sufficient. But there are other circumstances, which it is very material and useful in practice to attend to, which I shall hint in a general way, only referring to a more particular account in a dissertation I published in 1757. Where acrid matter, whether of medicine or disease, is applied to our body, externally or internally, we find, in many instances, that the matter directly enters the lymphatic vessels, and, before it shews its influence on the body in general, produces swellings of the glands through which the lymph, loaded with the medicine or other matter, naturally passes; *e.g.* It often happens, that blisters produce swellings in the conglobate glands, not in those next to which the blister is applied, or those lying immediately under it, but in those so situated as to receive the lymphatic vessels from the part blistered, however distant, as in the axilla, or inguinal glands, when the blister was applied to the hands and feet, and that without any pains spreading along the member; and surgeons often find that blisters of the head produce wax-kernels of the neck, their situation varying according to that of the blister.

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* MULLER, after stating that there is no doubt that the lacteal vessels absorb the chyle, adds, "there are circumstances, however, which prove the absorption by lymphatics in other parts. It is not merely that the lymphatics become painful, that red streaks appear in their course, that the neighbouring lymphatic glands become swollen after the application of irritating substances to the skin; the lymphatics, around collections of peculiar animal fluids, have been seen filled with these fluids." —*Vide* Translation by BALY, vol. i. p. 276.

† ASSALINI, SAUNDERS, GMELIN, and TIEDEMANN, and subsequently MASCAGNI and SOEMMERING, have made the same observation, and have been quoted by MULLER (vide Phys. translated by BALY, vol. i. p. 276), as "having all observed bile in the lymphatics coming from the liver, in cases where the bile-ducts were obstructed." That the lymphatic vessels possess a selective power, *i. e.* admitting some substances, was stated by Dr MONRO secundus, and has been most distinctly proved

The same is observable in diseases, as in the plague perhaps, but beyond all doubt in the measles, smallpox, cancer, and lues venerea. And, to give examples which will apply to all these diseases: In the lues venerea, recollect what you have seen of the effects in the common manner in which it is received; the inguinal glands swell, and constantly the swelling is produced in the uppermost gland or glands of the inguinal plexus. There are a number of

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by the experiments of the Academy of Philadelphia. Salts, according to the experiments of GMELIN and TIEDEMANN, are sometimes absorbed, but not colouring matters.

them running down the thigh, that are all supplied by vessels and nerves from the same root, but the under ones, though equally near, do not swell, but the upper; and I have repeatedly traced the lymphatic vessel hardened from the root of the penis into the groin; and I have traced a lymphatic vessel from the under part of the urethra, behind the scrotum, the whole way into the groin; and we sometimes find them imperfectly where the coats have been thickened and hard, as in the red veins.

In other cases, again, as in a cancer of the feet, the lower glands of the inguinal plexus swell first, plainly shewing that they swell in the course of the vessels; and if the venereal poison has been received another way, as if a surgeon receives it from a wound, or without a wound in the finger, a bubo is produced in the axilla. If a nurse communicates the infection to a child by giving suck, the child has a sore mouth, and the bubo is then formed in the neck; and if the diseased child communicates the infection to the nurse, the axillary glands are affected, and the neighbouring parts are free from the inflammation.

In like manner, in many other cases, where there is a suppuration, as in scrofulous cases, or in common sores, especially when they are exposed to the air and become acrid, we frequently meet with a swelling of the glands, and it is easy to prove, that these swellings were known to GALEN and to many others who had no particular theory to serve, nay, GALEN calls glands swelled from sores *bubones;* and we find the matter passing to a very great distance.* The evidence is clear, that the valvular lymphatic vessels are absorbents, and the idea of some, that lymphatics are wanting in the brain and some other parts, because anatomists have not yet injected them, scarcely merits refutation.* Are we to suppose an exception of one organ from general analogy of all the others, that the whole order not only of absorption but of circulation is inverted? The only reason assigned, is the difficulty of seeing them. I find a number of conglobate glands immediately under the brain, in proportion greater than could be supposed, unless the lymphatics of the brain pass through them; and wounds and suppurations of the brain have brought on swellings of the neck.† Supposing that the lymphatic system does perform absorption, does it follow that the absorbents do not likewise terminate in the red vessels, or that absorption is not performed by these also; or while the valvular lymphatic veins absorb, are we to suppose that the red veins assist in the same office?

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* Of the earlier authors, the works of HAASE, SHELDON, MASCAGNI, MONRO 2d, and CRUICKSHANK, are most worthy of consultation; and, of the latter, those of LAUTH, FOHMANN, PANIZZA, MAGENDIE, and MADDEN.

1*st*, It is not consistent with the simplicity of nature to make such a supposition, to suppose one set of veins serving the single purpose of absorption, and that the other set shall not only serve that, but likewise the purpose of circulation. It is more probable, that as the two kinds of veins correspond to different kinds of arteries, they correspond entirely, and that the one office has no communication with the other; but that the red veins serve for circulation, and the lymphatics for absorption‡ And if the structure had been fully understood before the other supposition had been formed, we might have allowed it to have more weight; but the red veins were known long before the lymphatics, and, therefore, were for many years supposed to serve every purpose in the body; and, even after the discovery of the circulation, they took for granted that the red veins served both for circulation and absorption; and it was not easy for physiologists, though they now began to treat matters more minutely, to divest themselves of their prejudices, and, instead of producing arguments against the former opinion, more were advanced in favour of it. Thus, it has been alleged that the lymphatic vessels are wanting in a variety of animals, which in other respects agree with man, so that absorption must be performed in them by the red veins. But we find that in the oviparous animals there are lymphatic vessels. They also allege the want of lymphatic vessels in certain places, because they have not been seen as in the brain and eye.* But I have met with a case that clearly proves this in a cancer affecting the inner parts of the ball; a very large swelling in the lymphatic glands in the bottom of neck of the same side which soon broke out into cancer. Next, they have applied to injections. An in-

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* The lymphatic vessels which accompany the branches of the arteries of the dura mater follow the same course, and, like the arteries, impress the inner table of the skull. I have seen them by filling a skull with plaster-of-Paris, and ARNOLD of Zurich has represented these lymphatic vessels in his beautiful and accurate representations of the brain.

† Dr MONRO secundus, at page 34 of his book on Fishes, observes, " I have discovered numberless lymphatics in their brain, eye, ear, and nose.

Swellings of these glands of the neck are frequently observed when water has been accumulated within the ventricles of the brain.

‡ Considerable stress has been laid upon the experiments of the late Sir E. HOME, who threw a ligature upon the great lymphatic vessels of warm-blooded animals, and injected substances into the stomach,

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which, notwithstanding, got into the circulation, and were detected in the brain.

But, considering the number of the lymphatic vessels and their frequent communications, it is conceived, that it is impossible to take up all the lymphatics, and even very difficult to prevent the progress of the chyle through the thoracic duct, which generally forms what anatomists have called islands. Hence life is continued though the thoracic duct is obliterated at one point; besides, the thoracic duct is sometimes double dividing at its upper third into two branches, one of which ends in the left and the other in the right subclavian vein; and further, in all subjects, the terminations of the lymphatic system of opposite sides of the body freely communicate with each other.

* I have seen in cases of Fungus hæmatodes of the eye, a swelled lymphatic gland situated at the side of the optic nerve.

jection is made into a vein, and it is found that some cavity is filled; and truly, water squirted back in the mesenteric vein will be effused; but it may have entered the artery and passed by its exhalant branches; and reversing the experiment, let us pour the water into the cavity of the intestines, and see if it enters the vein, and if we use coloured substances, or those that have a strong smell, and which readily enter the lymphatics, we find that *they do not enter the mesenteric vein.**

I have also observed where a number of the glands have been obstructed, suppose in the axilla, that the whole arm has become œdematous, and yet *the red veins were not affected*, and if these are provided with numerous absorbent vessels, why do not these perform their office? The tying the thoracic duct does not always prevent the flow of chyle into the blood. Experiments of this sort do not succeed, as *the thoracic duct, more frequently than is suspected, communicates with other veins*, as with branches of the vena cava within the abdomen, with the azygos within the thorax,† and near its usual entrance it has frequently more than one termination.

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* This observation is contrary to the experiments of Magendie, Flandrin, and Tiedemann, but upon such observation less stress should be made, considering the extreme difficulty of distinguishing an odour in a vein or lacteal vessel which runs upon and adheres intimately to the coats of that vein.

† The communication between the lymphatic vessels and the veins has been subsequently mentioned by Abernethy, Tiedemann, Fohmann, and Lauth. Dr Monro secundus was an opponent to the general doctrine, though he admits it regarding the veins of which he has made mention; and it is not a little remarkable, that Muller, whose Physiology has been published only lately, expresses precisely the same opinion. Vide his Physiology translated, vol. i. p. 241, he says, the thoracic duct has sometimes communications with the veins,—for instance, branches joining the vena azygos in the hog, and since even a right thoracic duct sometimes exists, whilst the absorbent vessels have frequent communications with each other, the application of a ligature to the thoracic duct cannot absolutely prevent the passage of the poisoned lymph into the blood.

In several experiments, I found that these terminations had been considerably dilated. On keeping the animal alive four or five days, I got it to take a quantity of food in which madder was mixed, and it ate the same quantity with other animals of the same age, in which the duct had not been tied; and yet the death of it was not to be presumed to have been *very much owing to want*, it had not *been nourished by it*, the bones had not received the smallest tinge, while in a sound animal they were tinged in half that time; so the mesenteric veins are not capable of absorption of chyle on the colouring principle of madder.*

Extract from Lecture XLVIII.

At our former meetings, after shewing the structure, course, and termination of the valvular lymphatics, I attempted to explain the termination of the arteries, and our meeting yesterday, we endeavoured to ascertain he origin of the veins, whether red or lymphatic.

Upon the whole, I endeavoured first to prove, that the experiments of authors by no means shew a communication or continuation of the lymphatic arteries with the valvular lymphatic veins. Next, that a variety of circumstances leads us, on the contrary, to believe, that all the circulating branches of arteries, when reflected towards the heart end in red veins, or that these correspond with the arteries, in so far as circulation is performed; and I mentioned a variety of arguments which shew that the valvular lymphatics are absorbents. Upon the whole, we concluded so, from the analogy of the lacteal vessels; from attending to their structure; to their valvular appearances in man; their continuing to be filled with liquor after the circulation has ceased; from the colour of their contents, particularly the green colour of those coming out from the liver. To these I add the effect which acrid matter, whether of medicine or disease, has in producing swellings of the lymphatic glands, that are interposed between the part irritated and the heart. Acrid matter in some instances enters our system without previous ulceration; this even happens in the lues venerea. I have examined patients who had bubo in the groin without finding chancre or gonorrhœa; and I find in FALLOPIUS an observation of the same kind, when the disease produced more violent effects than it does now; and in the plague, we find buboes in those parts of the body exposed to the external air. I was told by Mr KENNETH M'AULAY, that it is customary to inoculate children by rubbing matter upon the wrist, and, he observed that, in many cases, swellings were found under the arm-pit, though he did not know the cause.*

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* This observation has lately received very strong confirmation from an experiment of a distinguished Dutch physiologist *Van der Kolk*, who filled a portion of intestines with a solution of prussiate of potass, after which he dipped it into a solution of sulphate of iron, and could detect the blue colour only in the lacteal vessels.

If the chyle passed into the blood by the medium of the mesenteric veins, it seems difficult to give an adequate explanation of the cause of the extreme emaciation and debility, and subsequent death, of the victims of tabes. The lacteals are swelled, indurated, and reduced to a morbid state; whereas the mesenteric veins are found to be in a healthy state; to which it may be added, that when any part has been extensively diseased, as when large abscesses are formed, or where a part has been in a state of melanosis or fungus hæmatodes, the lymphatics, but not the veins proper to that part, are filled by the same disease.

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* DIAGORAS, CELSUS, ASCLEPIADES, ARETÆUS, AVICENNA, GALEN, and his followers, employed laudanum, mercury, turpentine, and other medicines externally; but, about the beginning of the eighteenth century, external applications were not used. Towards the end of the same century, however, they were again used, in consequence of the researches of Dr MONRO secundus, the HUNTERS, CRUICKSHANK, and MASCAGNI. But many years afterwards SEGUIN, CURRIE of Liverpool, and others, denied the absorption by the skin, an opinion now completely overthrown by the researches of EDWARDS, DILL, and WEST-

Of the Functions of the Absorbent System, or the general purposes which that system serves in our body.

The very first use that occurs to us, respects the lacteal vessels, that they serve for taking in our nourishment, and, what we say of the lacteal vessels, even in this view, seems, in some measure to apply to the lymphatics. I shall afterwards give reasons for thinking that, whilst we throw out a poisonous matter by the lungs, we, at the same time, take in something useful from the air, which has been of late doubted. Next, the absorbent system prevents the too great accumulation of liquors in the various cavities of the body; unless there was an absorption corresponding to the exhalation into these cavities, every such sac would soon become dropsical; and although this was not the case, although the exhalents did not supply more than is necessary to make a free motion, yet the liquor, by remaining long, would become

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RUMB, and by Drs YOUNG and MADDEN. Vide Essay on Cutaneous Absorption, Edin. 1838. Sir D. BARRY's experiments have shewn that the absorption by the skin is greatly diminished or suspended by diminishing the pressure of the atmospherical air. Thus, by applying a cupping glass, the absorption of a poison may be obviated. There is very great variety as to the rapidity by which absorption takes place in different textures of the body. Thus, marks on the skin, occasioned by tatooing, or made by gunpowder, are a sufficient proof of the very slow removal of the parts of the skin; whereas the disappearance of the colour communicated to bones by feeding an animal on madder, in a few days, proves the rapid interchange which takes place in the particles composing a bone.

The following observations occur in Dr MADDEN's essay on Cutaneous Absorption, p. 143:—" The experiments of SCHREDER and of WESTRUMB, related above, in which certain substances, applied to the skin, were afterwards found, some in the blood, and some in the lymph and chyle; the observations of Dr HANDYSIDE, that saline substances laid on the true skin, or on granulating sores, appear exclusively in the veins; and the experiment of MAGENDIE, in which such could be detected more easily in the subcutaneous cellular membrane than in any other part, shew at once how very uncertain are all our data, and how extremely difficult it must be to arrive at any definite conclusion."

acrid and hurtful. Hence the necessity of a constant change, and all the secreted liquors undergo it; so persons grow fat and lean, so the absorbents can take up from the adipose follicles the fat of the body, and there is a continual change of the fatty parts, and of all others in the same manner. We must also suppose that many changes are operated on the secreted liquors, in order to fit them for their several purposes; so we find that the bile in the gall-bladder is much thicker than, and materially different from, the bile found in the hepatic duct, having undergone a preparation, particularly the absorption of the thinner parts. In like manner, the fat is separated from the exhalent vessels, not of the same consistence as it is found in the adipose cells,—a watery fluid must have conveyed it there, which is afterwards reassumed. So in the parts that are exposed to the air, we find a sebaceous or mucous matter in the follicles or bags, as of the trachea, skin, &c.; surely this mucus has been changed by absorption. Perhaps we may push this one step further, and say that the absorbent vessels do not merely serve for the preparation of the secreted liquor, but that a somewhat, that is useful to the economy, is, at the same time, taken away and returned to the mass of blood, *i. e.* That by the secretion, such changes are produced upon the liquors, that when these are reassumed, they have different effects upon the body from the effects of the principles of the blood. Thus, it can be rendered probable that, in the jaundice, the yellowness is not owing to the want of the separation of the bile, but to its being returned to the blood, and if we can prevent the return, we can prevent the disease. Take another example: In the semen we certainly do observe that the whole constitution is affected by that; if this was owing to a want of separation, the fœtor observed in the flesh of bulls would be more remarkable than in the flesh of oxen. Nay, perhaps, somewhat useful is taken from those fluids commonly considered to be excrementitious;

thus the urine of fishes is not discharged from the body by the ureters, but is retained in a bladder of urine for a time, during which, a somewhat useful is abstracted from it.*

From what has been stated, the following inferences may be deduced regarding the functions of the animal body, and bearing upon the practice of physic and surgery.

1. Our views are enlarged by considering the absorbent vessels as valvular, for we see more distinctly the benefit in health and in disease, arising from the number of valves. From friction and exercise, the flow of the lymph is accelerated ; hence the use of these in a variety of diseases, as in the dropsy.

Next, following the vessels, we find they pass through glands before they reach the heart; we find in these a minute division of the vessels, in which the liquor, for some little time, has its motion diminished. Hence, the glands of the lacteal and lymphatic system are much exposed to obstruction ; and this will more readily happen in the lacteal glands, because a greater quantity of acrid and crude matter passes through them. We next perceive, from knowing the division of the lacteal vessels in the glands, the reason why sometimes, after the breaking of buboes or scrofulous tumours, there is a considerable discharge of watery matter.

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* I am led, by experiments, to suppose the coats of the lacteals to possess a greater degree of muscular power, or *tonicity* as it has been more lately called, than the coats of the lymphatics or arteries. Thus, when a dog is killed after the lapse of four hours from the time he has been fed upon butter, on opening the abdomen, we see the lacteal vessels ramifying upon the coats of the intestine, and passing along the mesentery, distended by chyle ; in about half an hour they become quite empty. And farther, I found that if, after throwing the ligature around the root of the mesentery, these parts be put into strong spirit of wine, with the view of coagulating the chyle within the lacteals, their coats are ruptured, a fact to me quite novel, and demonstrative of the strong contractile powers of the coats of the lacteal vessels, which has been denied by MASCAGNI.

Physicians are apt to consider this as owing entirely to a laxity of ruptured circulating vessels; but, from understanding the structure, we learn that it is owing chiefly to the flow of the lymph into the gland, which, in these cases, does not readily enter the vasa egredientia.

The lymphatic vessels and lacteals every where anastomose, and, whilst some of these vessels pass through the glands, others pass upon their surface, and, therefore, we can understand that an obstruction may happen in the lymphatic glands which a poisonous matter touches upon, but although the same poison be conveyed farther, the glands nearer to the heart are not affected.

Thus, with regard to the buboes (a consequence of the lues venerea) in the groin, I have often dreaded the formation of a similar bubo within the body, and yet I have not met with a single instance of it, or remember to have heard of one; and this is prevented, not merely from the warmth of the part, but especially from the poisons being diluted by the joining of the lymphatic branches from the inferior extremities, before the poison reaches the next glands. Keeping the same in view, we next learn the reason why a stoppage in a single gland does not produce an œdema in the vicinity of the glands, a number of the vessels passing over the gland, and carrying on the absorbed fluid towards the heart. By attending to the cause of the swelling of these glands, we are in many instances directed to the best mode of cure, as by knowing the cause of the venereal bubo, that it depends upon the venereal poison being conveyed directly into the gland. We endeavour to direct the mercury into the bubo in the groin, by rubbing in mercurial ointment on the inner side of the thigh; the lympathic vessels of that side of the limb being much larger and more numerous than those on the outer side of the member. This proves much more efficacious than administering the same remedy in the form of pill.

By attention to the state of the lymphatic glands, situated between a scirrhous tumour and the heart, it may be generally determined whether or not cancerous matter has formed within it, a circumstance of great moment to be ascertained, as it regulates the prognosis as to the chance of cure by an operation. Thus, in the case of scirrho-cancer of the mamma, if the lymphatic glands of the armpit be not swollen, the chance of cure is much greater than if these be contaminated. The swelling of these axillary glands originates from the direct translation of the poison; and hence I strenuously urged, in my original Essay on the Lymphatic Vessels, that the diseased glands ought to be removed, at the same time as the original seat of the malady, providing they have not attained a very large size, and have not contracted adhesions with the neighbouring large bloodvessels, and nerves.

In further evidence of the propagation of the disease from its original seat, it may be observed, that when these diseased axillary glands have not been removed, they are found, after death, in the same morbid state as the mamma.

Another way of judging where the glands are not so much enlarged, as that their swelling can be felt through the tumour, is from observing some degree of œdema. I have seen instances, where we could not, with the finger, distinguish any swelling of the axillary glands, and yet they were affected; but it was concealed by the œdema which had formed. Sometimes this is confined to the breast only, but in other cases the whole arm is affected, those glands being also swelled into which the lymphatic vessels from the arm terminate.

Next, by attending to the manner in which the glands are affected, the means to prevent diseased matter from affecting the constitution are obvious. Buboes occurring in the plague, appear in those places that are exposed to the air; so I presume, that the pestilential bubo often indicates that the matter is only entering the body, and, therefore, the best means of preventing the disease, will be to extirpate the bubo as soon as it appears. And, perhaps, we may from this draw another inference, that we may prevent the entrance of the plague in a certain degree, by properly covering the whole body, excepting only what is necessary for respiration. The parotid glands are often swollen, or rather the lymphatics over the parotid and maxillary glands; and more frequently the axillary than the inguinal glands, the hands being more exposed than the feet. It is the opinion of several eminent physicians, that the scrofula is a disease proper to the lymphatic glands, as if we would be free of that disease if these were wanting. But this is far from being a just notion; because, when I come to the diseases of the bones, I shall shew instances of spina ventosa or scrofulous caries of the bones, the disease first beginning there, and only afterwards occasioning these swellings in the lymphatic glands; and, therefore, the scrofula is to be considered as a disease of the system, more readily appearing in the lymphatic glands from their office, the diseased matter being conveyed through these to the heart. In the same manner gonorrhœa and lues venerea are two distinct diseases, and in the latter a chancre is produced from a different cause from that which produces gonorrhœa; but to shew that they are nearly the same, buboes are frequently produced in the same manner by both, and by the same kind of poison.

From considering that the matter enters the body and affects these glands, I have hinted at the expediency of extirpating a pestilential or cancerous bubo. Suppose that a surgeon, in extirpating a cancer, wounds his finger, and that the matter gets in and causes a swelling in the axillary gland, he ought to extirpate the gland, at the same time destroying the wounded part by cautery, or caustic. But if the disease is of a curable nature, as the venereal disease, why should we subject the patient to the cruel operation of having a bubo extirpated, as was done last war? By attending to the kinds of the swellings, we can vary the method of cure, and probably, by external applications, do more good, by directing medicines of various kinds immediately into the glands and vessels that are diseased.

The great danger of diseases of the lungs is, from the preceding observations, obvious; for all absorbed matter passes to the right side of the heart, suppose from the hands or lower extremities, so the lungs more immediately receive the taint. When the disease originally begins in the lungs, the absorbed matter passes through the bronchial glands, and immediately returns to the lungs; so passes in a circle, and the lungs, with more difficulty, get rid of the taint. And from comparing the course of the lymphatic vessels in the aortic and pulmonary systems, we perceive an advantage attending the inoculation of the small-pox. When the disease is received from the air, it is directly drawn into the cells of the lungs, and is in danger of irritating these; for the poison of diseases affects that part of the system which it touches more than the rest. Thus the poison absorbed passes into the bronchial glands, which become inflamed and indurated; whereas, if we inoculate, the infection does not immediately fall upon organs that are of the utmost importance to life. In its concentrated state, the poison is diluted with the blood, passes to the skin, and suppurates. And from the same consideration, I have been led to propose the inoculation of the measles, where the affection of the lungs is a pathognomonic sign; thus the lungs would not so readily be irritated; and since that time, viz. in the year following, Dr Home has made some experiments with regard to this. But, as yet, the number of experiments that have been made is not such as to determine this point.

When dropsical sacs are emptied of their water by giving purgatives, diaphoretics, or diuretics, the effect has been imputed to the action of the medicine upon the alimentary canal, or to its action on the arteries of the skin, overlooking their effects upon the absorbent system.

As the solids, as well as the fluids, are absorbed by the lymphatic vessels, an overaction of this system may produce a wasting of the body.* On the other hand, from the want of proper tone and activity of the lymphatic vessels, useless or hurtful matter may remain and accumulate on the solids, as is perhaps the case in scrofula, and may prove the cause of various disorders.

Lastly the lymphatic vessels possess what may be called a selective power, admitting certain substances, and rejecting others.†

The lymphatic vessels do not merely absorb, but produce a change on the matter they take up; thus the nutritious part of the food does not coagulate spontaneously, until it is lodged within the absorbent system.

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* I published, some years ago, in Dr DUNCAN's Annals, vol. viii., a case of diabetes highly illustrative of the above remark. I found the body most excessively emaciated, the fat converted into jelly, whilst all the lymphatic vessels and glands connected with them were very much enlarged.

† MAGENDIE denied the absorbing power of the lymphatic vessels, an observation confirmed by experiments performed on horses by FLANDRIN and DUPUYTREN. But that the lymphatics are absorbents has been proved by my father, and by experiments lately performed by LAWRENCE, MAYER, and SCHROEDER, VAN DER KOCK, and by MULLER of Berlin, who observes that the lymphatics do really absorb, but their absorbing action is confined to particular fluids, for which perhaps they have an affinity. Some foreign matters, such as salts, are taken up by the lymphatics, although with difficulty, while others, such as colouring matters, are generally not absorbed at all.[1]

[1] Vide translation by BALY, vol. i. p. 279.

ESSAY II.

OF THE CHARACTERS, CAUSES, CONSEQUENCES, AND MODE OF TREATMENT OF INFLAMMATION.

When any part of the body swells, with an increase of heat and redness, attended with pain, it is said to be inflamed.*

This state of inflammation may be excited by external as well as by internal stimuli.

If an external stimulus be applied to a single organ, that alone is inflamed. Thus an inflammation may be excited in the right eye, by powder of glass thrown into it, with little or no inflammation of the left eye. From this it appears that the inflammation does not proceed from a general action, such as that of the heart; but is owing to effects produced in the part stimulated.

When the part inflamed by such means is accurately examined with the microscope, we observe, 1st, That the vessels, which in the sound state convey the red particles of the blood, are enlarged; and, if there has been a wound or ulcer in the part, the open mouths of the vessels are dilated and pour out the red blood. 2dly, That the number of vessels conveying red blood, seems to be increased; and hence we cannot help supposing that many vessels, which naturally circulate the colourless parts only of the blood, are so much dilated as to admit the red globules. And this conjecture appears to be supported by the observation, that when the kidneys or other glandular organs are much irritated, the quantity of the liquors they secrete is increased, their qualities perhaps altered; and the irritation continuing, the red particles of the blood sometimes pass into their excretory ducts. 3dly, We farther perceive that there is an effusion of the colourless parts of the blood, often tinged with red particles, into the interstitial cellular substance.* 4thly, If the inflammation is of some du-

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* In the preceding memoir of my father's life, it will be observed that the publication of his opinions upon the causes and effects of inflammation had paved the way for the modern opinions on the diversity of inflammation of the different tissues. In the following lecture, the first of his course of Surgery, my father has fully developed his views of the different inflammations of different tissues; and it will be observed, that these views are, in many respects, in the most perfect accordance with the opinions of the most modern authors.

The subject is not treated in detail, it being the object of a lecturer to give the most prominent features, but not the minutiæ.

I plead, as an apology for the length of my notes affixed to this Essay, the importance of inflammation in a practical point of view.

Dr MONRO's description of the causes and effects of the inflammation of serous membranes, are contained in his book on the Bursæ Mucosæ.

* In the book I published some years ago, upon the Morbid Anatomy of the Gullet, Stomach, and Intestines, I described in detail the genuine appearances of inflammation of the mucous membrane of the alimentary canal, and also the varied causes which produce an alteration in the colour of the mucous membrane. It is extremely difficult and perplexing to distinguish genuine inflammation of mucous membrane; it is, however, a matter of the greatest practical importance, especially in cases of real or supposed administration of poisons.

All accurate anatomists are agreed, that the mucous membrane of every part of the alimentary canal is not of the same texture or colour; but the morbid states of the mucous membrane have not yet been investigated with the degree of minuteness which their importance demands. An acquaintance with these states may, in the case of suspicion of poison having been administered, lead to the detection of the guilty; and also to an improved method of treating the diseases of this membrane.

During an examination of the state of the mucous membranes, several circumstances should be kept in view.

1*st*, That during the process of digestion of the food in the stomach, ration, new vessels are formed, which add to the bulk and

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the mucous membrane of that organ assumes a red colour,—an observation which also is applicable to the mucous membrane of the uterus and vagina, at the period of menstruation.

2*d*, The mucous membrane of the stomach, from congestion of blood, assumes, in the feeble as well as the more robust, on some occasions, a red colour, which is discriminated from that of inflammation with great difficulty, even by an experienced observer. This is owing to the capillary vessels being full of blood, and when they are dilated there is a tendency in the blood to coagulation: hence the mucous membrane is at first red, and afterwards brownish or purplish.

3*d*, In cases of sudden death, the mucous membrane of the stomach and intestines frequently is of a red colour, especially if immediately before death, the deceased had been in good health. An examination of the stomachs of persons who have been killed by hanging cannot be considered as a criterion upon which a judgment should be formed as to the colour or texture of the mucous membrane in its sound state.

I have had occasion to examine the bodies of several of those who have forfeited their lives to the violated laws of their country, but have not observed a uniformity of appearance in the mucous membrane. The stomach was generally of that colour which has been called by Mr P. Syme *Tile-Red*.

According to Dr Yellowly, who has also devoted much attention to this subject, "the mucous membrane of the stomach of five executed criminals was of a *red or crimson hue*, and this colour was most marked on the first day; and soon afterwards, but at irregular intervals, became very obscure."

It has been stated by some eminent authors, that when death is sudden, the mucous coat of the stomach is afterwards partially dissolved; but in the majority of instances which I have examined, it was not acted upon in the slightest manner.

Further, even in the most healthy stomach, the capillary vessels of some portions of the mucous membrane are found to be partially distended, which gives rise to those red spots which are sometimes observed, and this is owing to the coats of the blood-vessels retaining their power, after the action of the heart has ceased. In cases of chronic inflammation, owing to the stagnation of blood in the minute vessels and the changes it undergoes, the affected parts become purple, brown, grey, and even greenish; and this I have seen even when the fibrin of the blood had been effused, and when there were deep spots of deep lake colour in the immediate vicinity.

4*th*, The peculiar position of the body has also an effect upon the colour of the mucous membranes of the stomach and intestines, as the redness of the part. Thus, in chronic inflammation of the

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blood accumulates in the vessels of the most dependent part, or it even transudes, in a few cases.

5th, An examination of the mucous membrane of an inverted womb or rectum, does not convey a correct idea of the colour. The displaced parts being irritated, the blood is determined to those parts, whilst, at the same time, the return of the blood is more or less resisted through the veins, which, being more or less distended, give the coats of the displaced portion a purplish colour. If the prolapsus be of long duration, the mucous membrane of the inverted bowel assumes the colour and consistence of the skin.

6th, Irritation from intestinal worms gives rise to redness of the mucous membrane, and also to the secretion of a red jelly, which may be mistaken for the effects of inflammation, though the redness does not originate from such a cause, but from an uncommon determination of blood to the irritated part.

7th, The innermost coat of the stomach has sometimes acquired a red colour, in diseases connected with debility, when these have shewn no previous symptoms of inflammation. I observed this red appearance in a very striking manner in the body of a young woman who died from diabetes, whose body I examined at the request of my late worthy colleague Dr Duncan sen., and who published it in his Annals of Medicine, vol. viii. p. 392. Since that period, I have observed similar appearances in the bodies of persons who had died from other diseases, and where there was no reason to suspect inflammation to be the cause of the redness. This uniform and general redness sometimes pervades the inner coat of the arteries; and it is worthy of particular remark, that it is not to be imputed to inflammation, for the other coats of the stomach, intestines, or arteries, are not reduced to a morbid state; whereas, if inflammation be the cause, the redness extends to the other coats.

8th, In my Morbid Anatomy of the Gullet, &c., I have described the case of a lady who discharged by the anus, at different periods of her life, considerable quantities of coagulable lymph. The effusion of coagulable lymph has been stated by some authors to be one of the most certain indications of acute inflammation; but, in this case, the pulse was not accelerated, nor had she pain of the abdomen, or any other of the usual concomitant symptoms of inflammation of the intestine.

9th, A certain degree of putrefaction also communicates a reddish colour to the mucous membrane of the stomach and intestines, which may be mistaken for the effects of inflammation. This circumstance gave rise to the suspicion, that King Charles of Sweden, the predecessor of Bernadotte, had been poisoned by a slow vegetable poison, tunica adnata of the eye, we observe new formed vessels extending from the adnata over the surface of the cornea.

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similar to the *aqua tofana*. The prince had been seized, after having partaken of a pie at an inn, with violent vomiting, loss of appetite, and frequent colic. But, upon reflecting on the history of the case, it was evident that he had died from apoplexy. He had suffered much from acute headach and giddiness, and fell from his horse during a review of his troops, some days before his death. His body had not been examined with care, and not until the lapse of some time; and I am persuaded that the reddish colour of the mucous membrane of the stomach was to be imputed to the effect of incipient putrefaction.

It may often be difficult to distinguish the spots produced by putrefaction from those which are frequently observed in the healthy stomach. MAHON has furnished a criterion. He states, that, if the stomach shall retain its natural colour, and the spots on it are marked red, while the borders of the ulcers are livid pale, putrefaction is the cause of the change of colour.

It may be also remarked, that an infusion of red poppy, or tincture of cardamon, gives a red tinge to the mucous membrane of the stomach, which may be mistaken for the effect of inflammation.

The numerous observations of my late pupil Mr SWAN, have proved, in the clearest manner, that the insertion of a piece of gamboge, or the oxide of arsenic, or the rubbing mercurial ointment on the back of a dog, after shaving off the hair, communicates a red colour to the mucous membrane of the stomach and intestines, and that the mercury occasions an inflammation of the great sympathetic nerve.

There is a more difficult case, which deserves notice. If a corrosive substance be injected into the anus, well-marked inflammation is excited.

ORFILA made several experiments, in order to determine the effect of injecting poisons into the anus. Several dogs were hung, and, a short time after death, a quantity of corrosive sublimate, in the form of powder and in small fragments, was introduced into the rectum.

On examination, the mucous coat of the intestine near the anus was found *of a rose colour*, but, immediately above, the rectum was of its natural colour; so that there *was a distinct line of demarcation* between the parts to which the sublimate had been applied, and those which had not been in contact with it.

On the same experiment having been performed upon a living dog, an intense redness was observed, which extended eight inches, gradually diminishing in intensity, and leaving *no distinct line of demarcation*. Similar effects were produced with arsenic. Verdigris, however, left no trace

In short, there can be no doubt that in an inflamed part there is an increased action of the vessels. As the

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of demarcation or corrosion on the rectum of the dead dog, while it ulcerated the living parts. The sulphuric and nitric acids produced no other effect than their chemical one. Dr TARTRA found that he could produce on the dead, as well as on the living body, that yellow-orange colour which is the characteristic of nitric acid.

A mucous membrane, when inflamed, is, no doubt, *frequently red, but not invariably so.* The redness is, in some places, intense, and forms small points, patches, or streaks, which are produced by extravasated blood.

If the inflammation be intense, the mucous membrane looks like a piece of red velvet, and has a rugous surface, from the enlargement of the mucous glands. The redness does not go off on pressure; there are red circles around the bases of the mucous glands, and in the centre of these there are little cavities, which are also red.

In order to see these appearances distinctly, it is requisite to wash off the vitiated mucus, or coagulable lymph, which covers the inflamed mucous membrane, and to make use of a good magnifying glass.

The distended veins under inflamed membrane are conspicuous.

If the mucous membrane of the gullet be the seat of inflammation, the cuticular lining is raised into little blisters or aphthæ, and, upon removing these, the surface is found to be abraded.

The mucous membrane is at the same time softened. This is sometimes remarkable, even when the redness has disappeared. The above remark does not apply to the lungs, which, by inflammation, acquire very much the appearance of the liver, which is owing to the air-cells being filled with blood. They want, however, their healthy cohesion, being easily broken down; thicker than usual, owing to the accumulation of blood, and retention of the effused fluids in the part; and of the *buff-orange colour* of Mr P. SYME, intermixed with *tile-red*, and a *slight shade* of *lake-red.*[1]

The inflamed mucous membrane may be readily separated from the subjoined membrane, owing partly to the softening of the cellular membrane, and partly to the effusion of serum; hence the swelling or œdema of the affected part.

By the more acute inflammation of the mucous membrane, it is reduced to a state like mucus, and is sometimes cast off, leaving the muscular fibres quite bare.

The inflammation generally spreads from the mucous to the other muscular fibres of the arteries are circular,* it follows that their direct action can serve only for the diminution of the

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[1] Vide P. SYME's Nomenclature of Colours, which is a very useful key to the accurate discrimination of different shades of the same colour.

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coats of the affected part, which may be readily separated from each other, owing to the serum which is effused between them. The muscular fibres appear, in consequence of inflammation, like fine striæ.

By chronic inflammation, the mucous membrane of the stomach acquires a partial reddish colour, inclining to yellow: it is rougher on its surface, which may be readily distinguished by drawing the finger along it; and a part of it assumes somewhat of a fungous appearance.

The redness induced by inflammation has sometimes gone off after the lapse of twenty or thirty hours. This is not the remark of a superficial, but of an acute observer, Professor HORNER of Philadelphia, who has directed much attention to this very important inquiry. He observes, "The traces of acute inflammation are in many cases very fugitive, and entirely disappear upon death, because the local irritation which attracted the blood and accumulated it having ceased, the blood abandons that part, and retires towards the centre of the circulation. We can seldom tell by the appearances, twenty-four hours after death, the quantity of blood which has penetrated an inflamed membrane, as the peritoneum, the pleura, the cellular and mucous membranes, the skin, &c. The eruption of measles and the redness of sore throat disappear on the death of the patient.[1] We are not, however, to infer from these circumstances that the mere afflux of blood to a part constitutes inflammation; on the contrary, it is attended with a dilated condition of the vessels, independent of this afflux; for, if death occur during the height of the measles, the eruptions may be made to reappear by injecting the vessels. BICHAT has very properly observed, that in inflammation we should distinguish between acute and chronic affections, because, though the blood readily vanishes from the former, yet it will remain in the latter, because it has combined with the diseased organ. Hence, induration, suppuration, and vitiated secretions, are satisfactory signs of inflammation of a part."

BICHAT has added, that if the inflammation be chronic, the appearance of inflammation does not go off, as the blood continues within the vessels.

* Some modern authors do not admit, that the coats of the arteries are endowed with a muscular power. I have invariably endeavoured to controvert such an opinion, which is perhaps little more than a quibble about words, as all authors must admit that the arteries possess the pro-

[1] In various inflammatory diseases of the skin, it assumes a purplish hue, and the cuticle is more quickly detached, the tendency to decomposition being very rapid after death.

artery; hence, according to some authors, a relaxed state of the arteries was the cause of inflammation, or they possessed some power of dilating themselves. Mr JOHN HUNTER (Treatise on Blood and Inflammation, 1794, p. 282–3) observes, that the vessels in an inflamed part are enlarged; from which we would suspect, that instead of an increased contraction *there was rather what would appear an increased relaxation of their muscular powers*, being, as we might suppose, left to the elasticity entirely. And he concludes, that in inflammations the muscular coats of the arteries do not contract, because we suffer greater pain in the diastole of the artery. An inflamed bladder of urine, he observes, becomes extremely painful when expelling its contents. But on this it may be observed, that the inflamed bladder would become still more painful, if it were suddenly distended by an impulse, resembling that of the heart; and, farther, that the pain of an inflammation is constant, whether its arteries be in a state of diastole or systole; and if it be greater in their diastole, let it be recollected that the diastole of the arteries, or their dilatation, is much more sudden than their depletion, being performed in nearly half the time. When the stomach is inflamed the mildest drink gives a great degree of pain, and excites vomiting.

Such theories are surely inadmissible. Does irritation produce the contraction, or the dilatation of a muscular fibre? Or is it conceivable that muscular fibres can, by any direct action, dilate a tube they surround? Can it be supposed, that the circular muscular coat of the intestine can, by its direct action, dilate the intestine? Surely not.

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perty of diminishing their calibre, and even when no heart exists, as in the monster described by my father in the Transactions of the Royal Society of Edinburgh; nor does the absence of fibrin (as stated by BERZELIUS) in the middle coat of an artery invalidate such an opinion—considering that an artery possesses irritability and contractile power, the most characteristic property of the muscular fibre.

The phenomena seem to me to admit of explanation on the following principles. All the arteries possess irritability, and contractile muscular power, and, from the readiness with which inflammation is excited by stimuli applied to small arteries, such as those of the tunica adnata of the eye, there is good reason to believe that the small arteries possess both properties in a more eminent degree than the larger trunks.*

In the next place, the natural stimulus given to the arteries passes in succession from the heart, by the trunks of the arteries, to their extremities; and, in fact, the arteries near to the heart beat rather sooner, than those which are distant from it. That is, in all parts the larger branches are dilated, by the action of the heart, sooner than the smaller; for, whilst the heart is in its systole, there is a progressive dilatation of the arteries from the heart to their extremities. When the heart ceases from acting, a progressive contraction of the arteries from the heart to the extremities of the arteries takes place.

Farther, as the arteries circulate the blood in the most perfect manner, by being alternately dilated and contracted, we must suppose, that by nature they are, like the heart, so constructed, as to assume alternately these two states. Thus, the heart of a turtle or frog, when cut out, continues, though empty, to contract and relax itself alternately for some hours.

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* There is every reason to suppose that the muscular power of the smaller arteries is greater than that of the larger. They are more energetic in carrying on the processes of nutrition and secretion, and are even more under the influence of the nervous system, as the electric shock, considerable mechanical injuries, and sedative agents almost instantly arrest the circulation of the blood in the capillary vessels. A local determination of blood is by no means unfrequent, and it is different from inflammation, and is often combined with a want of action in other parts of the body. Thus from intense study, the face sometimes becomes much flushed, which is accompanied by throbbing of the carotid and temporal arteries, whilst the feet are cold, though somewhat livid, a proof of torpor in the circulation.

In consequence of the overaction of the arteries of the part stimulated, the particles composing their coats will be distracted, and the spaces between them increased. Hence, when their systole is over, they will yield to the force of the heart, or to the contraction of the arteries situated between the heart and the inflamed part, and, by degrees, will be dilated. To prove that on such principles the dilatation of the arteries may be explained, it may be observed, that the whole heart is occasionally not only dilated, but increased in thickness and weight, from the ossification of the valves of the aorta; and, in like manner, the alimentary canal is expanded, and its coats thickened above the place of intus-susceptio or stricture, which can only be accounted for from the overstraining of the muscular fibres of those organs, in order to overcome the unusual resistances opposed to the progress of the contents. The effusion of fluids into the cellular substance and interstices of the vessels, and likewise the mixture of the red with the colourless part of the blood, can be readily explained from the increased force with which the blood is impelled into the exhalant branches of the arteries.

The greatest difficulty, perhaps, is to account for the production, or growth of new vessels, which is to be imputed to irritation. Thus, upon laying open the cavity of the abdomen, and admitting the air for a little time, inflammation is excited; and, on tracing the progress of it, we observe, first, crusts formed by the coagulable part of the blood upon the surface of the bowels, and afterwards new vessels penetrating these, and joining different contiguous bowels to each other. These new vessels are perhaps produced by the exhalant vessels becoming enlarged and elongated, somewhat in the way that cut or open-mouthed vessels are extended from the opposite sides of a wound.

In short, in my opinion, all the phenomena of inflammation may be accounted for, on the supposition of an increased contraction of the bloodvessels.

On like principles, the cause of dilatation of the veins of an inflamed part admits of explanation. Besides, more than the usual quantity of *blood is pushed into them* by the inflamed arteries. The irritating matter of infectious diseases or acrid matter, any how generated within the body, attacks certain organs more readily than others ; and *where inflammation is excited*, it puts on a different appearance, according to the structure of the organ.* *But I differ from Dr CARMICHAEL SMYTH in thinking*,† *that the appearances of inflammation in the skin, the cellular membranes, the diaphanous and mucous membranes, the muscles and joints, will be precisely the same, in whatever way and in whatever constitution the inflammation has been excited*;‡ *when we reflect*, 1*st, that the same kind of irritating matter attacks and inflames very different organs ; for instance, few organs are exempt from the attack of the venereal poison, or matter generated in scrofulous habits, and erysipelas begins in the skin of the head, but, sinking deeper, attacks the brain itself*;§ *and*, 2*dly*, *That very different kinds of in-*

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* Vide Dr CARMICHAEL SMYTH's observations on the different kinds of Inflammation.

† Dr CARMICHAEL SMYTH, Med. Com. vol. ii. 1790, xix.

‡ This opinion has been fully verified by subsequent observations. Many examples may be given as illustratious of this remark : thus, exposure to cold gives rise in some constitutions to tubercles of the lungs, in others to fever or sore throat. There seems to exist in come constitutions a liability to give rise to organic diseases, and especially to the formation of tubercles. Persons of a scrofulous habit of body, from very slight causes are attacked by a low degree of inflammation, which gives rise to the growth of tubercles, and to swelling and induration of the different lymphatic glands, and more especially to those of the neck.

§ There is also internal erysipelatous inflammation, most frequently of the peritoneum, which gives rise to puerperal fever.

It seems to be extremely probable, that there is a peculiar poison in the bodies of the victims of puerperal fever. I have seen repeatedly the most urgent symptoms produced by the examination of the bodies of some who have died from puerperal fever, and even when the fingers had not been injured, or in so very slight a degree as to escape examination by the aid of a powerful magnifying glass, and further the poison generated in the arm of the anatomist, is of so acrid a description, as to produce similar symptoms in the nurse who dresses the arm of the patient.

fectious matter, not only excite inflammation in the same part, but the appearances of the inflammation vary according to the nature of the infection. Of this the numerous tribe of phlegmasiæ and exanthemata furnish abundant proof. Thus, one kind of irritating matter produces erysipelas,* but another, the variolous, produces phlegmon of the skin.

There is another circumstance very peculiar in this poison; it produces not only redness, swelling of the arm, side of the chest, and same side of neck, and very acute fever; but a swelling and induration in the deeper-seated lympathic glands, which continues for the remainder of the life of certain individuals.

A specific or spreading inflammation of the mucous membrane of the fauces, accompanied by aphthæ and typhoid fever, sometimes prevails epidemically, and has been described by BRETONNEAU of Tours, and Professor HAMILTON of this city.

In short, the characters, progress, prognosis, and mode of treatment of different specific inflammations, have been of late very ably explained, and the effects of the multiplication of morbid poisons in the blood. Thus, the inflammation of *syphilis* falls on organs of a peculiar texture.

Much light has been thrown upon the characters, and peculiar malignity of specific inflammations at peculiar times, their mode of multiplication, and connection with a peculiar state of the blood, the prognosis and mode of treatment.

Thus, Messrs ABERNETHY, PEARSON, ROSE, GUTHRIE, and CARMICHAEL of Dublin, have pointed out very clearly the varieties in the forms and progress of syphilis in different individuals at the same time, and the gradual change in the malignity of the disease, and its aggravation by the abuse of mercury.

Dr WOLLASTON has proved the existence of uric acid in gouty concretions, which tends to explain the connection between a gouty and calculous diathesis, which is probably to be imputed to a morbid state of the blood. In the same manner, the presence of semitransparent globules in the fibrin of the blood of a healthy individual, detected by GENDRIN, and their absence in incipient tubercles, seem to lead to the opinion of a morbid state of the blood being the cause of disease, to which opinion is opposed the fact, that in rheumatism, a morbid state of the blood is not detected.

* My late colleague Dr DUNCAN, Mr LAURENCE, and Dr BUTTER have shewn, that when this inflammation extends from the skin to the cellular tissue, it preserves the same local characters in the latter as in the former, and this I have seen to prevail epidemically, and it has been

Upon the whole, it seems legitimate to conclude, *that there are as many species of inflammation as of infectious diseases; and the proof of this is, that the inflammation which the infectious disease excites, generates more of the infectious matter which excited it; that is, every inflammation so excited performs some specific action, and produces certain effects proper to it.*

Having considered the general nature of inflammation, let us now attend to the effects or terminations of it.

I begin by observing, that if inflammation be not removed by proper remedies, or the efforts of nature, it may prove fatal in two very different ways.

1st, It may interrupt the exercise of a function on which life immediately depends. Thus, in the inflamed state of the lungs, called Pneumonia, the effusion into the cells of the lungs may be so great as to prevent the air from entering the lungs in such quantity, or in such a manner, as is necessary to maintain life. Or an inflammation of the brain may prevent that organ from furnishing, or exciting, the nervous energy.

The other way in which inflammation occasions death is by no means fully understood. In this latter, death is occasioned by the inflammation of a part not necessary to life, and which, without danger, may be separated from the rest of the body. Thus, an inflammation of the gum, the effect of dentition, often occasions convulsions, followed by death; or the same happens after laceration of the fingers; or an inflammation of the joint of the knee, after a wound of its ligaments, has terminated fatally. In such cases, the fatal effects proceed from the sympathy of the brain with the nerves of the part inflamed; but, from our ignorance of the nature of the nervous energy we cannot explain the cause of such effects.

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said to be propagated by inoculation, as in the case of wounds received in dissection, and this is accompanied by a great depression of the vascular system, derangements of the nervous system, or typhoid fever.

If the inflammation abates, but is not entirely removed, it lays the foundation of other disorders, in consequence of the effusion which it occasions.

In the first place, beyond a doubt, inflammation may give rise to scirrhus, or that kind of hard tumour, which, when irritated, terminates in a cancerous ulcer; hence blows upon the mamma, the liver, the testis, and other glands, have instantly excited inflammation ending in scirrhus. I am disposed to go a step farther, and to allege, that scirrhi in general, or perhaps all scirrhi, have derived their rudiments from some degree of inflammation, just as we suppose, on finding the lungs adhering to the sides of the thorax, that a preceding inflammation has produced the effect. In both cases, the preceding inflammation may have been so slight that the person had suffered very little distress from it.

Where, in consequence of inflammation, such hard tumours form, as commonly terminate in cancer, I have observed, that the effused matter is very opaque; that it is much heavier than water, sinking very quickly in it; and that so great a part of the tumour is composed of it, that, on injecting the vessels, these are found to be much less numerous in the diseased than in the sound part of the organ. From these appearances, and from the fact that, when such tumours are irritated, they degenerate into cancer; it seems probable, that the vessels from which the effusion was made, had, by some power resembling that which glands possess, changed the principles of the blood into matters of a noxious quality.

We next often observe, that, during inflammation, or when it has considerably abated, an effusion of a watery serous fluid takes place, but which, when examined, is found to resemble the serum;—or inflammation sometimes lays the foundation of dropsy.* This effect may proceed partly from a more irritable and active state of the arteries, and perhaps that their exhalant branches have been dilated by their over exertion, and relaxed afterwards.

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* According to Drs Cullen, Rush, Cheyne, and others, the acute hydrocephalus originates, in general, from inflammation; and Black-

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all, Abercrombie, and Crampton have imputed general dropsy to the same cause, and have added that it is repeatedly renewed by inflammation, and that it admits of relief to a certain extent by venesection.

Notwithstanding the weight of the evidence on one side, still there is strong evidence to be put into the opposite balance. On a former occasion I have expressed my sentiments upon the cause of hydrocephalus; and, with the exception of the most acute form of the disease, which proves fatal in two or three days, I am disposed to impute the disease rather to debility than inflammation,—an opinion by no means rashly adopted, and to which, with the exception of a single instance, I still adhere. I have subjoined the arguments I formerly used.

The morbid appearances most frequently discovered on dissection, are generally hostile to the hypothesis that hydrocephalus acutus is connected with inflammation.

The pia mater very seldom exhibits, in cases of hydrocephalus, those appearances which, according to the late Mr J. Hunter (a very competent judge), are the genuine marks of inflammation.

That distinguished surgeon has observed (p. 281), "When inflammation takes place in parts that have a degree of transparency, that transparency is lessened. This is probably best seen in membranes, such as those membranes that line cavities, or cover bodies in those cavities, such as the pia mater, where, in a natural state, we may observe the bloodvessels to be very distinct. But, when we see the bloodvessels *fuller than common, yet distinct in such membranes, we are not to call that inflammation.*"

There is no part of the body in which it is so difficult to make the distinction between the presence or absence of inflammation, as in the pia mater.

The pia mater did not bear, even according to Dr Quin, all the characters of genuine inflammation,—it was not thickened,—it did not adhere intimately to the substance of the brain, as in cases of inflammation of that organ. According to that distinguished pathologist, Dr Baillie, "when the pia mater is inflamed to a high degree, pus is formed."

Dr Quin does not state that he discovered pus upon examining the state of the brain of persons cut off by hydrocephalus.

Besides the thickening of serous membranes, as the dura mater and arachnoid coat, a preternatural adhesion of these generally follows the inflammation of those membranes. The result of my post-mortem examinations is, that, in a very few cases only, there were appearances of preceding active inflammation.

In many cases in which inflammation has preceded dropsy, some induration remains in the part which was in-

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There is one point more difficult to determine, whether a morbid accumulation of blood really exists; and *granting that it does exist, whether it be connected with inflammation or not?*

Until the precise caliber of bloodvessels shall be ascertained, it is quite impossible to say when blood can be said to be accumulated in those vessels. Blood, when accumulated in the bloodvessels, must occasion an enlargement of these, which does not suddenly happen.

Inflammation is not the necessary concomitant or sequel of an accumulation of blood in the bloodvessels. The eye, for instance, often acquires a red colour, though the pulse be not accelerated, and though there be no degree of pain in the eye or forehead, and no degree of impatience of light, or any other symptom of active inflammation.

The vessels of that part of the brain which was lowest, were, in *in many instances, fuller of blood than those of the uppermost part of that organ, which evidently is connected with the position of the head rather than with inflammation.*

As the different advocates for the opinion, that hydrocephalus is connected with inflammation, have published very different statements as to the kind and degree of inflammation, it does not seem to me to be against the rules of evidence, to suppose, as it is so difficult to distinguish the genuine characters of inflammation, that, in some of the instances, *no degree of inflammation had existed.*

Of the identity between hydrocephalus and dropsy there is at least presumptive, if not positive, evidence.

There is an analogy between the cause of hydrocephalus and of dropsical disorders. Hydrocephalus, like dropsy, more frequently originates from debility than from inflammation, and is a frequent disease of infancy,—a period of life when the human frame readily bends under the pressure of every cause which enfeebles the power of the constitution, as of long continued fever, scarlatina, phthisis pulmonalis, marasmus, measles, hooping-cough, and diseases of the liver, spleen, and mesenteric glands.

Dr HAMILTON senior has justly observed, "that hydrocephalus often steals slowly on the devoted victim, with symptoms resembling incipient marasmus."

Till some better theory is established, it is not unreasonable to suppose, that *the marasmus of which I have treated, may, on some occasions, give rise to hydrocephalus, by impairing the vigour of the constitution, and favouring serous effusion into the ventricles of the brain.*

It may be added, that MORGAGNI* has mentioned the case of an elderly woman, which strongly illustrates the great influence of debility

* Vide COOKE's edition, vol, iv. p. 18.

flamed, which induration affects the veins more than the arteries; and hence the cause of increased exhalation by

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in producing hydrocephalus; it is said, "she sank progressively to her grave, as under the pressure of age."

The detraction of blood has sometimes occasioned dropsy of the abdomen or chest. The same observation may be extended to hydrocephalus, of which I published a striking example formerly.

The experiments of Dr **Seeds** have also shewn, that the excessive detraction of blood gives rise to the effusion of water within the head.[1]

The result of his experiments is, that the sinuses and veins of the brain of animals bled to death from veins, are commonly more turgid than when death has been occasioned by blood drawn from an artery, and he adds, "Si sanguis plurimus sive ex arteria, sive e vena affluxerit, *aqua intra caput effunditur.*"

An impediment to the free return of the venous blood is the most frequent cause of hydrocephalus, as also of other dropsies: hence hydrocephalus is frequently connected with tumours of the brain, or with an enlargement of the pituitary gland; with tumours of the neck; or with enlargement of the heart, and the occipital lymphatic glands, and diseases of the lungs; or with any cause which impedes the free return of venous blood, as by tumours pressing upon the superior longitudinal sinus, torcular Herophyli, or the jugular veins.

Hence we meet with the effusion of water within the ventricles of the brain of criminals who, when in perfect health, have been killed by suspension. It is remarkable how soon the effect follows the operation of this cause. I found about half an ounce of water at the basis and within the lateral ventricles of the brain of a criminal, whose body I examined immediately after execution; and in other criminals, after the lapse of a few hours.

Dr **Kellie** of Leith, in his very ingenious paper upon death from cold, has observed, "The effusion which was discovered within the heads of our subjects, can hardly be regarded as a post-mortem production; nor can it be presumed that it existed previous to their exposure on that night which terminated their existence. The perfect parallelism of the two cases,—their agreement with another case by **Quelmalz**,—their simultaneous exposure and death on the same night that another individual died under similar circumstances, render such a supposition highly improbable. If this serous effusion were not a post-mortem effect, and if it had no existence previous to the exposure of the individuals, then we must conclude that the whole, or the greater part, was effused in the short interval between their exposure and their death."[2]

[1] Vide his Thesis, "De Sanguinis missione," Edinb. 1815.

[2] Vide Transactions of Medico-Chirurgical Society of Edinburgh, vol. i.

the arteries also often proceeds from relaxation chiefly: Thus a paralytic limb becomes œdematous.

The accumulation of a certain quantity of water within the ventricles of the brain, probably gives rise to a farther effusion. The branches of the veins distributed on the lining of the lateral ventricles, the vein of GALEN, and velum interpositum, are compressed. On the same principle, hydrothorax sometimes gives rise to anasarca; or hydrothorax is the prelude of hydrocephalus.

A suppression of the usual discharges is stated by authors to be one of the most frequent causes of dropsy, and the same observation may be extended to hydrocephalus. Dr GOLIS (a warm advocate for the opinion that hydrocephalus is connected with inflammation of the brain and its membranes) has justly stated, "When the urine is unnaturally scanty, the physician ought to be on the watch for an affection of the head."

Hydrocephalus, like other diseases, is very frequently connected with scrofula, and is undoubtedly most frequently found in scrofulous families; and those tubercles which are so frequently observed upon the membranes or surface of the brain of scrofulous persons, probably are of the same nature as those of the lungs and intestines, which do not originate from inflammation, in the opinion of BAYLE, LAENNEC, or ANDRAL *junior*.

If, in the families most frequently afflicted by hydrocephalus, we do not meet with ulcers decidedly of a scrofulous character within the brain, or in the other parts of the body; we may observe the same florid and clear complexion,—the same lively disposition, the same delicate, but relaxed, fibres, with the same quickness of apprehension, the same feeble action of the heart, and want of vital energy, so often noticed in scrofulous children.

The appearances on dissection, in cases of hydrocephalus, scrofula, and dropsy, are similar.

When water has been accumulated within the ventricles of the brain, scrofulous tumours in the vicinity of the venous sinuses, or in other parts of the brain, are occasionally found, scrofulous tubercles of the lungs or liver, and a scrofulous enlargement of the mesenteric glands.[1]

The analogy between hydrocephalus and dropsy, may be further traced from the effect of the remedies by which both diseases have been occasionally relieved or cured.

Hydrocephalus is occasionally removed by the same remedies as other kinds of dropsy, though, on account of the peculiar structure of the brain, and the effects of the disease in deranging its structure, the cure is more uncertain.

From what has been above stated respecting its origin, causes, and

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[1] Vide Cases of this kind described in my Morbid Anatomy of the Brain, p. 49.

In other cases an exudation of the coagulating lymph, instead of serum, follows, and the surface of the inflamed parts, particularly of the bowels, is covered with a crust, which becomes a medium of adhesion between them. On tracing the texture and progress of the crust (and you will recollect that I shewed you the event of experiments I had

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appearances on dissection, instead of regarding hydrocephalus as generally connected with inflammation, it is rather to be imputed to scrofula, or to those causes which occasion a derangement in the circulation of blood through the brain, through the viscera of the chest[1] and belly, than to inflammation of the brain, or to what has been called Subinflammation by authors, and which causes it to act peculiarly on a scrofulous habit.

I have no doubt that visceral obstruction and dropsy derive their origin frequently from chronic inflammation, and more especially from the granulated or tuberculated state of the cortical part of the kidney, which Dr BRIGHT has proved to be often indicated by an albuminous state of the urine. The morbid state of the kidneys alters and diminishes the quantity of urine that is secreted, as a consequence of which (as Drs CHRISTISON and BOSTOCK have proved) the blood is reduced to a morbid condition. When the urine becomes albuminous, and its specific gravity low, the serosity of the blood is loaded with urea, and inflammatory diseases frequently take place, followed by organic diseases of the brain and lungs. In the last stages of these diseases, the quantity of urine is much diminished, and frequently fever and slight coma, with Ischuria Renalis, follow.

The presence of serum in the urine has been supposed by Dr BLACKALL, to be the index of inflammatory dropsy, but he has not proved, that those dropsies in which it does not contain serum, are never conjoined with inflammation. Dr CRAMPTON speaks decidedly on this point, and observes, " In many of those, which appeared to me to require the prompt use of the lancet, *the urine did not coagulate*."

It may be added that anasarca frequently originates from debility, and admits of cure only by tonic remedies.

According to SOLON (Sur l'albuminurie ou hydropsie causée par maladie des reins, Paris, 1838) the urine of a number of patients afflicted by acute diseases, may be expected to become albuminous, previously to their recovery, a fact of very difficult explanation; shewing, that albuminous urine is not an invariable pathognomonic symptom of certain morbid states of the kidney; and Dr COPLAND has affirmed, that he had observed coagulable urine in the acute diseases of children, "*where no alteration of the kidneys existed*."

[1] When the heart is diseased, water is generally found within the ventricles of the brain. This connection between diseases of the heart, and the effusion of water within the head, has been much insisted upon, and happily illustrated, by Dr CRAIGIE. Vide Edinburgh Medical and Surgical Journal, vol. xix. p. 68.

made for that purpose), we observe that, in the space of a few hours, an adhesion begins to take place.

If the common cellular substance be the seat of inflammation, the effused lymph blocks up the communications between the cells, or renders the cellular membrane impervious, and increases much the thickness of it, so that when the subcutaneous cellular membrane is inflamed, the skin is elevated and feels thick and hard.

We often meet with a combination of the serous and lymphatic effusion. Thus, in the disease called Hydropericardium, the surface of the heart is covered by fibrin; and in some cases of hydrothorax, the lungs and pleuræ were encrusted; and in the fibrin, there are not only fibres like those of the cellular substance, but vessels conveying the red blood. The number of these, by degrees, increases prodigiously, and these new vessels pass in opposite directions, and connect the contiguous bowels.

Argument is unnecessary to disprove the opinion of Mr John Hunter, that the effused lymph or blood forms vessels by some plastic power,* as experiment shews that the vessels are extended from the original vessels, and that the effused lymph or blood serves merely as a bed in which the vessels shoot. Nay, it may perhaps be a question, whether the effused lymph or blood continues to make a part of the new formed substance, or whether the whole of it is reassumed or absorbed by the lymphatic vessels? Just as it may be a question, whether any part of the cartilages in which bones form, remains after the ossification is completed? In very violent inflammations, and particularly of the lungs, which are not only of a spongy texture, in which the velocity of the blood is certainly greater than in any part of the aortic system, and in which the momentum is perhaps likewise greater in the small branches of the pulmonary artery than in the small branches of the organs which derive their blood from the aorta, the red particles are effused along with the lymph. If red blood be effused into shut sacs or cells, and not in considerable quantity, nor exposed to the air, the effused clot, instead of putrefying, may, like the effused lymph, be pierced with bloodvessels, which, in time, may connect the neighbouring organs to each other.* Thus, where bones are fractured, the red part of the blood is effused with lymph; the red part is afterwards absorbed, the lymph remains, and vessels shoot into it.

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* Mr J. Hunter on the Blood, p. 92, tells us, "The coagulum forms vessels in, and of itself."

But, in inflammation, besides the effusion of the parts which compose the mass of blood, we often observe matter formed, which we call pus, or a suppuration is said to take place. The purulent matter is thick, opaque, of a yellowish colour, and when we expose it to the microscope, is found to contain many small globules.

The parts which contain purulent matter are by degrees wasted, particularly such as lie between it and the external surface of the body. Thus, if purulent matter collects under the skin, we find the subcutaneous cellular substance first wasted, and then holes are formed in the skin. Whilst this wasting process is going on, we find that the purulent matter is prevented from spreading, like water in an anasarca, by a general adhesion to each other of the parts which surround the purulent matter, or we say, that a boil or abscess has formed.

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* Dr G. Burrows, in his Croonian Lectures on the Pathology of the Blood, Med. Gaz. vol. 18, has broached an opinion which seems to me very ingenious. He says, "in every structure there is a point where the blood must be regarded as becoming extravasated, where it mingles and combines with, and renovates the surrounding tissue—where, in fact, it becomes organized, and where its vitality is no longer a matter of doubt."

Mr J. Hunter had entertained an opinion somewhat similar. He has observed, that, "when the blood has once coagulated in the living body, and become a solid, it then changes into this or that particular kind of substance, according to the stimulus of the surrounding parts."

Such hypotheses have been lately revived by Dr Carswell, and by Andral, which shew that small coagula of effused blood may undergo the same changes—as when it coagulates within the arteries or veins, it acquires a distinct structure, adheres to the neighbouring parts, and undergoes various morbid transformations.

It has been supposed by Sir John Pringle and Mr Gaber, that the lymph is poured out unchanged, and afterwards converted into pus, by the absorption of its thinner parts: in proof of this they state that pus may be formed from the lymph of the blood. But if this be admitted, lymph discharged by a recent wound should produce pus in a very short time, which is not the case; and, on the other hand, the formation of pus in an ulcer should go on much more slowly than in their experiments; or a recent wound and an ulcer should produce pus in equal times, which is far from being fact.

I have, therefore, always ventured to allege that the lymph, or other parts of the blood were, by a certain or specific action of the vessels, converted into pus,* or that this assisted in its formation, *and that an ulcer or an isuse was to be considered as possessing the. power of glandular organs.*

The wasting of the parts, in consequence of which the purulent matter is at last discharged, has generally been supposed owing to a corroding quality of the purulent matter, acquired by its fermentation or putrefaction. But, although I will not venture to deny that such a process ever takes place (because the matter sometimes becomes extremely fetid before the air has had access to it); yet, commonly, pus derived from a sound part of the body, has no offensive smell. The solids as well as fluids are wasted and renewed. It is probable that the waste is much greater than ordinary when a part is stimulated and its absorbents excited by inflammation. Hence the waste of parts, for instance the formation of holes in the skin, is in part owing to an unusual degree of absorption of the solids. How far, each of these causes, to wit, fermentation, solution by liquors which the exhalants pour out, absorption by the lymphatics, contributes to the destruction of the solids, remains to be determined by experiments.

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* Pus is now-a-days considered not a "conversion" but a *new secretion.*

There is much affinity between the adhesive with the suppurating process, and the one passes readily into the other. Thus, when an abscess is forming, the middle part of it suppurates, while the effused lymph, and the adhesive inflammation at the edges of it, glue together the parts of the cellular substance, and confine the pus. On the other hand, if the pus be let out from the abscess, an adhesive inflammation frequently follows, proving a bond of union between the opposite sides of the abscess.

This affinity is still more evident in the case of a wound of the skin. If the skin, after being cut and raised from the other parts, be immediately replaced, it often adheres to the parts below without suppurating, or the cure is performed by what is called the *First Intention:* But if dressings be introduced between the skin and parts it covers, or if the inner side of the skin be from any cause kept exposed to the air, its inner part suppurates. In like manner, after a steatome situated in the cellular and adipose substances under the skin is removed, and the skin replaced, the cut edges of the wound exposed to the air suppurate, whilst the rest of it adheres without suppuration, to the subjacent parts, or is joined to them by the adhesive inflammation.

From the above it is evident, that where a wound has been inflicted, the air should be excluded, by bringing the lips of the wound into contact with each other. If this, from loss of substance, as in some amputations, cannot be done, we should exclude the air by proper dressings; and, for this purpose, and likewise for lessening irritation, it is proper to spread mild ointment upon the lint employed in dressing.*

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* It has been stated by ARNOTT and others, that inflammation is often succeeded by depositions of pus in the cavities of the joints or internal cavities, and by GUTHRIE, ROSE, DANCE, and VELPEAU, that the same

The last termination of inflammation is in mortification, which follows two very opposite states of our organs.

The vessels are, in one of these, by slow degrees, and, without a very evident cause, deprived of their active powers, and become unfit to propel their contents. Thus, in a few cases of typhus, accompanied by great weakness, I have seen mortification take place in the feet, without previous complaint of pain.*

In other cases, without previous typhus, or any other known sedative or stimulating cause, a person grows languid, and then observes redness in some particular part, generally in the toes or feet. This generally-fatal disease, very rarely attacks both feet at the same time. Without giving much pain, it terminates in a mortification which generally proves fatal. The pulse becomes quick, small, and soft. I attended a remarkable case of this kind with Mr Russell, in which, in a man forty years of age, in good circumstances, and not exposed to cold, or any kind of hardship, two of the small toes grew black and cold. In a few days thereafter, although he had, in the mean time, taken a nourishing diet, with wine and bark, the point of his nose became cold and livid, his pulse and strength by degrees sinking; and he died before any of the black or livid spots separated from the rest.†

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happens after amputation of a limb, and by Gendrin, that the veins, especially in chronic cases, which issue out from large abscesses, are often filled with pus, and also that the conversion of the blood into pus happens, not only in extravasated effusions, but within the vessels of inflamed parts, in a certain state of that disease.

* In all cases, gangrene is to be apprehended from inflammation excited, when the powers of the constitution have been much depressed, and tho powers of the circulation are feeble.

† It has been the opinion of some authors, that this kind of mortification, which generally proves fatal, even to persons not far advanced in life, is the sequel of ossification of the coats of the arteries; but, although it is frequently connected with such a cause, it is not invariably so. This is a fact of which I am perfectly confident, from post-mortem examinations.

The coats of the arteries of the inferior limbs of persons far advanced

On the other hand, mortification sometimes succeeds violent inflammation, the concomitant of anthrax or carbuncle, and is attended with great pain; or we observe it after severe erysipelas, or confluent smallpox, in dysentery, or following an inflammation of parts extremely sensible, such as the stomach or intestines; or where inflammation is excited by acrid liquors, particularly urine effused, or after contusion and gunshot wounds, or after extensive burns, which are attended with great pain, a sense of heat in the part, and a quick and throbbing pulse.

Hence it appears, that in many instances where, in consequence of irritation and pain, an excessive action of the vessels is excited, the excessive action terminates in the loss of the vital power of the part affected, for reasons very difficult to assign. In consequence of this a relaxation of the coats of the vessels and porous exudation of the humours, followed by putrefaction, take place.

Although I admit that, where, from severe contusion, a large quantity of blood is sometimes effused, the putrefaction of the blood may promote the mortification; yet, upon reflecting that part of the red blood is often effused from inflammation, or that, in consequence of blows, or in venesection, ecchymosis to a considerable extent happens without mortification, it is more probable that this effusion is the consequence, rather than the cause, of mortification.*

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in life, are very rarely found in a sound state. They are generally ossified to a greater or less extent, and I have seen several such cases occur without the slightest degree of mortification of the toes, feet, or leg being present. On the other hand, some of the French and British surgeons have imputed the mortification to an inflamed state of the internal coat of the arteries, and have treated this disease, and often successfully, according to the antiphlogistic regimen.

* The reader is referred to the Microscopical Observations of Dr Wilson Philip, and Drs Thomson, and Hastings, and Andral, and Gendrin, on the nature of the process of inflammation. These shew, according to Dr Alison the inadequacy of any explanation of the process, based upon the changes in the contractile power of the bloodvessels of the inflamed part.

Of the Treatment of Inflammation and its Consequences.

We endeavour to disperse it, 1st, By lessening the general momentum or force of the blood in its circulation, by opening a large vein or artery, if the patient be young or of a plethoric habit, by which the tension and reaction of the heart and vascular system are diminished. The detraction of blood is beneficial, even when the size of the vessels of the inflamed part is not diminished, as when the brain or spinal cord are inflamed.

2d, The force of the blood in the part affected is to be lessened by pressure upon the trunk of the artery, which conveys blood to it; or by opening this vessel.

3d, If this cannot be accomplished, blood should be drawn from some artery, which communicates freely with the arteries of the diseased part.

4th, If neither of the two last-mentioned means can be executed, blood is to be taken from the small vessels of the part affected, or from small vessels communicating with these. And, for this purpose, we scarify the part, or apply leeches to it, and then promote the flow of the blood by cupping-glasses.*

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* Our improved knowledge of the inflammation of different tissues, and of the causes of it, has led to the introduction of various new antiphlogistic remedies, adapted to peculiar cases. Mercury is certainly highly useful, and has been very highly recommended in cases of inflammation of the liver, and of the mucous membrane, by the late Mr CLINE, by ARMSTRONG, and TRAVERS, and various others. Mercury proves of benefit, not only by its purgative effect, but also by increasing the flow of bile, and it has been supposed to control the effusion of coagulable lymph, upon which the danger of inflammation greatly depends.

It has been supposed that mercury is only useful in diminishing the inflammation of mucous membranes which occur in hot climates, but it is also useful in the inflammation of mucous membranes of the rectum, and its beneficial effects are visible in the prolapsus ani. Mercury, in chronic inflammation, acts not merely as an antiphlogistic, but also as a deobstruent remedy. In Iritis, mercury proves a most valuable remedy.

5th, Purgatives are likewise to be employed, especially when the digestive organs are deranged, as they not only discharge part of the circulating fluids, but perhaps have some effect of relaxing the diseased vessels, by diverting the course of the blood from them towards the stomach and intestinal canal. The nearer the inflamed part is to that canal the effect will be the greater, and hence laxatives have been found of singular use in hepatitis.*

6th, After these evacuations blisters are applied with great advantage near to the part affected.

7th, In all cases attended by danger, the force of the blood is to be diminished, by raising and supporting the part affected, as much as can be done conveniently, above the level of the heart.

8th, We enjoin rest, as muscular action increases the quickness and force of the circulation.

9th, We recommend a cooling and spare diet.

10th, We dilute with watery fluids, and to these add acids and acescents, which lessen the stimulus, reduce the

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A solution of tartar emetic is a useful auxiliary to the lancet, in cases of rheumatism, and inflammation of the chest, but it is imprudent to place our chief reliance on it. The late Dr Armstrong, and my distinguished colleague Dr Alison, have much lauded the use of laudanum in the inflammation of serous and mucous membranes of the abdomen after bleeding has been premised, and without any diminution of the alvine excretion. The opium given in this way relieves the pain and vomiting and procures sleep.

"That opium," says Dr Alison, "as an auxiliary to blood-letting in these inflammations, can lessen the quantity of blood to be drawn, is very doubtful; but it may be confidently asserted, that it will enable patients to bear loss of blood under which they otherwise would have sunk, and thus permit the effectual remedy to be applied repeatedly, and ultimately with success, in cases where it otherwise would have become inapplicable."

The above observations I saw verified, in a case of inflammation of the intestines, which I attended along with Dr Alison.

* Sir A. Cooper highly recommends two or three grains of calomel at night to increase the flow of bile.

pulse, and heat of the body. To place in a clear point of view the beneficial effects of dilution, you will recollect a fact I observed to you when treating of the principles of the blood, that the lymph of the blood after it is let, attracts or absorbs a considerable quantity of water poured upon it.

11th, Watery fluids, which relax and lessen pain, are to be applied, and we join to them vinegar, with lead dissolved in it, which experience proves to be sedative: Thus when we dip our fingers into vinegar, we find they are benumbed.*

12th, If the inflammation has been the sequel of external violence, as of wounds or contusions, or of burning, opium, after evacuations, is necessary not only to alleviate the pain, but to check the overaction of the vessels, and lessen the danger of mortification. On the same principles, perhaps, opium has been found of great use in the confluent smallpox.†

If we fail in the attempt of removing the inflammation, and that, from its nature and situation, it becomes advisable to promote suppuration, in order to shorten the confinement of the patient, and to relieve him, by creating a discharge of matter from the diseased part, we then ought to avoid evacuations.

To support the circulation by nourishing diet, wine, stimulants, and tonics.

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* Many surgeons have found the most beneficial effects to result from applying cold water to stumps. For this purpose, the extremities of worsted threads are introduced into a tub of water, and the opposite ends are applied to the stump. These act as syphons, and thus the cut surface is always kept cool, and free from inflammation.

† The beneficial effects of opium after wounds, contusions, or extensive burns, are now explained on different principles: the medicine is employed to counteract the effects upon the nervous system, and the general sinking from such a cause.

To apply to the part warm fluids and poultices, which seem fitted for promoting a process resembling fermentation, and which, by their heat, may serve to rouse the absorbents to an increased action; and with such view the poultices ought to be changed more frequently than is done in common practice. Stimulating substances, which excite inflammation in the skin, and therefore accelerate its destruction by the absorbent vessels, are likewise mixed with or spread upon the surface of the suppurating poultice.

When an inflammation, especially after a contusion or burn, is so violent that we dread a consequent mortification, we ought to counteract the tendency by bleeding, and especially by local bleeding and other evacuations. And, in some cases, as in that species of mortification which attacks the toes and fingers, Mr Pott has found opium and emollient poultices of great benefit.

When, however, a mortification has made some progress, the whole nervous system is debilitated and unhinged. Whether this be owing chiefly to the effects of the mortified substance on the nerves with which it is in contact, and sympathy of the rest of the nervous system with these, or to the absorption of the putrid humour, which certainly takes place (as Bilguer has observed, that the lymphatic glands between the part mortified and the heart are swelled), cannot, as yet, from want of experiment and observation, be determined.

In this debilitated state of the patient, we ought to support him by such kind of food as is easy of digestion, and at the same time nourishing, and should also endeavour to counteract the pernicious effects of the putrid matter applied to the nerves, or which has been conveyed by the lymphatic vessels into the course of circulation. For these purposes, on the authority of Bilguer, wine and bark are chiefly to be employed; he has proved that the bark possesses singular efficacy in preventing mortification, and in supporting the patient under it, and especially in cases of hospital gangrene.*

An outlet should also be given to the putrid humours, and to promote the separation of the dead from the living solids.

I would propose to discharge the putrid humour by small punctures, so as to prevent the free access of the external air, and to make slight incisions in the gangrened parts, with the view of more effectually discharging the putrid matter, and giving opportunity to the dead solids to contract more easily and separate themselves from the living parts, just as cutting slightly the eschar we have made by caustic, for the purpose of forming a pea-issue, accelerates its separation.†

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* Antimonial diaphoretics are of considerable use after the inflammation has subsided, especially when taken in combination with opium.

† Drs Monro and Paisley, in the Medical Essays of Edinburgh, published cases illustrative of the efficacy of karb in promoting the separation of the mortified eschars. According to some, bark is of no use when the mortification originates from an external cause, and it proves highly pernicious when the mortification is accompanied by great derangement of the abdominal bowels, and purging. Dr Robertson, however, dissents from such an opinion, and has informed me, that while in the public service, he necessarily had to treat many cases of traumatic gangrene. In these he not only gave bark internally with excellent effect, but used to fill the mortified wounds (after they were washed clean) with pulvis cinchonæ in the dry state; and always found it a valuable antiseptic. In order to allay irritation, and mitigate the patient's sufferings, opiates should be prescribed. Much difference of opinion prevails as to the propriety of amputating the mortified limb. Sir A. Cooper is hostile to amputation, when the toes or foot is mortified; and adds, if the operation be done, mortification of the stump follows. Dr Thomson is of opinion that amputation accelerates the mortification, and adds most justly, that until adhesive inflammation comes on, and a distinctly marked separation of the dead from the sound parts takes place, amputation is in few, if in any, cases admissible.

ESSAY III.

ON THE STRUCTURE OF THE WINDPIPE AND LUNGS, AND SOME OF THE ORGANIC DERANGEMENTS OF THE LUNGS AND PLEURÆ.

The air passes into the lungs* by the medium of the windpipe, which is prevented from collapsing by eighteen or twenty cartilaginous rings, which occupy its fore part and sides. These are covered and joined to each other by a very long ligament, composed of remarkably elastic longitudinal fibres, by means of which it readily accommodates itself to the bended or extended posture of the neck.

The large branches into which the trachea divides, commonly called *Bronchi*, are supported in their circumference by smaller cartilaginous segments of circles, tied together by similar elastic ligaments.

The cartilages of the trunk, and large branches of the trachea, are also joined together by transverse and longitudinal muscular fibres; and these in the back part of the trachea, where cartilages are wanting, are thicker than between the cartilaginous rings.

The cartilages and their muscles are lined both in the trunk and branches of the trachea by a thin and nearly transparent, and very sensible membrane, connected to them by cellular substance, in which numerous mucous glands are lodged.. These glands on the fore part and sides of the trachea are small, and disposed in regular circles between the cartilaginous rings; on the soft back part of the trachea they are larger, more numerous, in the same place, and more irregularly placed.

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* The illustrative figures, delineated and engraved by Mr Thomas Donaldson, with the preparations from which they were executed, were demonstrated to the Philosophical Society of Edinburgh, on the 17th of November 1763; and in January 1767, my father read to them his Remarks on the Lungs.

Their ducts open into the trachea by orifices, which are visible to the naked eye, and which, with their branches within the glands, could, I found, be injected with coloured wax.

In the tubes which are continued from the bronchi to the air-cells, and which have been called *membranous*, we do not distinctly perceive muscular fibres; yet it appears to me that they must possess a muscular power, in order to enable them to expel their contents accurately.

The small lobules into which each of the five large lobes of our lungs are subdivided, are very irregular in their shape and unequal in their size.

The air-vesicles of the same lobule, and likewise those of the neighbouring lobules, communicate so freely with each other, that from one of the small membranous tubes a number of the lobules of the lungs may be inflated or injected with coloured wax.

The lobules are connected to each other by a continuation of the cellular substance, which joins the pleura pulmonalis to the external surface of the lungs; and this passes deeper between some of the lobules than between others of them.

The proper air-vesicles of the lobules have no communication with the cells of the interlobular cellular substance, so that in many of my preparations the proper air-cells are fully distended with air or with wax, coloured with vermilion, without a particle of the air or vermilion getting into the interlobular cellular substance.

Each of the lobules of the lungs is covered by a dense membrane proper to the lungs, which we may compare to the pia mater of the brain, whilst the pleura pulmonalis resembles the arachnoid coat.

None of the membranous branches of the trachea anastomose with each other in their course to the lobules, as our arteries or veins do, the communications of their different ultimate branches being solely produced by the passages or holes in the sides of the air-cells which lead from one cell to another; and I could perceive beyond a doubt, that the air-cells are much more numerous than the ultimate branches of the trachea, or that a chain of air-cells is interposed between the terminations of the different ultimate branches of the trachea.*

After injecting the lungs of an adult with air and quicksilver, and particularly after injecting them with melted wax, coloured by vermilion, before the thorax was opened, in order to prevent them from being extended beyond their size in the living person, I examined them, by the assistance of the microscope, with the utmost attention, in different subjects, and found that the air-cells are somewhat unequal in their size, and irregular in their shape, in the same as well as in different persons, but are visible to the naked eye, and, at an average, may be reckoned to measure in their diameter $\frac{1}{80}$th part of an inch.

The ultimate branches of the trachea are likewise visible, those of the adult measuring, at an average, between $\frac{1}{80}$th and $\frac{1}{100}$th part of an inch.

When we now consider the explanation which has been given of the intimate structure of the lungs, it appears that the internal surface of the air-cells is nearly thirty times greater than that of the whole external surface of the body.

Thus the air-vesicles being only $\frac{1}{80}$th of an inch in their diameter, there will be 512,000 of them in one cubic inch.

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* Vide Plate 4. in the 2d volume of my Elements of Anatomy, 2d edition. According to REISSEISSEN, the bronchial tubes progressively are subdivided, but never anastomose, and their ultimate branches terminate in the air-cells, upon which there is a network of minute arteries and veins.

If, next, we suppose that the cells are of a cubical shape, which we may do without a material error, the sides of the cells will be six times more numerous than the cells; or their number in a cubic inch will be 3,072,000; and if from this number we deduct one-third, on account of the holes by which the cells communicate with each other, two millions of membranes remain, each of them equal to the square of $\frac{1}{80}$th of an inch, or the surfaces of the whole will be equal to 312 square inches, or upwards of two square feet; and as our lungs in a full inspiration contain about 220 cubic inches of air, the whole internal surface of the lungs will be nearly equal to 440 square feet, or nearly thirty times greater than that of the whole external surface of the body, which is generally supposed to be equal to 15 square feet.

Of the Proportion which the quantity of Air we respire bears to the Quantity of Blood circulated in the Lungs.

If the heart of a man in health beats 64 times in a minute, and at each pulsation expels an ounce of blood, and that in the same space of time he breathes about sixteen times, and in each inspiration receives about one-half of the quantity of air which his lungs are capable of containing, or 110 cubic inches of air, it follows that about 27 cubical inches of air are necessary to ventilate each ounce of blood.

Notwithstanding the great extent of the field on which the circulating vessels of the lungs are distributed, the expanse of the circulating vessels of the aortic system far exceeds that of the pulmonary, therefore the velocity of the blood in the vessels of the pulmonary system is much greater than in similar branches of the aortic system. Hence more blood is discharged from a wound of the lungs than similar wounds of another part of the body.

There seems likewise some reason to suppose, that although the momentum of the blood is less in the trunk of the pulmonary artery than in the aorta, as the thickness of the right ventricle does not exceed the third part of that of the left ventricle; yet the momentum as well as the velocity of the blood may be greater in the small branches of the pulmonary artery than in those of the aorta, as the force of the right ventricle is spent on a field, which is beyond doubt not equal in extent to one-third of that of the aortic system, as the weight of the lungs does not exceed $\frac{1}{30}$th part of the rest of the body.

It has been very generally supposed, that in the spasmodic asthma, the muscular fibres of the bronchi or of the cells of the lungs, or both conspiring, occasion the difficulty of breathing. But the cartilaginous segments in the former would prevent them from being contracted to such a degree as to have this effect: and in the cells there is not only *no appearance of muscular fibres*, but after they collapse in moribund animals, no contraction is excited where these are stimulated. But a general contraction of them, and diminution of the cavity of the lungs, such as is supposed in asthmatic persons, cannot take place, unless the lungs were to act with such force as to separate themselves from the pleura costalis, by overcoming the whole weight of the atmosphere, and forming a void between them and the pleura costalis, which it is absurd to suppose.

It has, therefore, always appeared to me that the spasm is chiefly seated in the transverse and oblique arytenoid muscles of the larynx, which I find have the power of completely shutting the glottis.

The sense of suffocation about the larynx, so oppressive to asthmatic persons, and which is often occasioned by irritating vapours, as soon as they reach the larynx, gives countenance to such an opinion.

Dr CARRICK, who received his degree of Doctor of Medicine in this University, after hearing me mention this opinion, put it to the test of experiment, by making an opening in the fore part of the trachea of a living dog, and with a probe irritating the larynx and the bronchi.

The irritation of the larynx produced instantly an asthmatic fit. But the irritation of the bronchi did not affect the breathing, because, as I suppose, their muscular fibres are feeble, and the cartilaginous segments which surround them, prevent them from shutting the passage for the air.

That the diaphragm, the intercostal and abdominal muscles also act irregularly and spasmodically in the asthma, seems likewise true: and, in some cases, I have observed the cardia contracted, and the stomach distended with air during the asthmatic fit.

On the Inflammation of the several parts which compose the Thorax, and its consequences.

Formerly various names were very generally employed by authors to discriminate the different seats of inflammation in the thorax, or it was believed that the seat of the inflammation was readily distinguishable by the proper or particular symptoms it produced.

But, of late years, it has been alleged that certain parts of the thorax are much less frequently inflamed than had been imagined; and that an inflammation is very seldom confined to one part of the thorax, but shifts rapidly from one part of it to another; and, hence, that its seat is not distinguishable by particular symptoms.

It has been further contended, that it could be of no use to make such distinctions, because the method of cure and remedies are the same in all these cases.

In order to judge with accuracy of these opinions, I shall state and demonstrate the appearances, discovered upon inspecting the bodies of those who had laboured under inflammation of the thorax.

1. In various cases, chiefly of persons of a scrofulous constitution, I have found purulent matter collected between the pleura costalis and the intercostal muscles, or behind the sternum in the cellular substance of the anterior mediastinum, and, in some of these, where the pro-

gress of the disease had been slow and little attended to, as it was neither accompanied with acute pain nor violent fever, one or two of the ribs or the sternum were carious: and the pleura was evidently thickened and opaque, without any observable disease of the lungs.

2. In a considerable number of other cases, lymph, mixed with a yellow substance generally understood to be purulent, the particles of which exposed to the microscope I found to be globular, has been found collected within the cavities of the pleuræ; and the pleura has been observed to be thick, opaque and lined with a crust, without any appearance of wasting ulceration, or erosion as it is called, of the pleura costalis, pleura pulmonalis, or substance of the lungs. The lungs have appeared to be soft, flexible, and without tubercles.

If this matter remains indeed long within the pleura, the lungs may come to be ulcerated.

In six such cases in which I was certain of the effusion of a fluid from feeling in all, and having heard also in some of them, the undulation of the matter, I directed the operation of puncture or incision to be performed. From one to two pounds of matter were discharged, in four of these cases; four pounds were discharged in the fifth case; and near to thirty pounds in the sixth case: and in this last case, which I placed under the management of Mr Benjamin Bell, the diaphragm was convex towards the abdomen, descending as low as to the umbilicus; and by striking the abdomen with one hand, whilst I applied the other to the ribs, I distinguished the undulation of the matter.

In two of these cases, air was mixed with the purulent matter discharged by the wound, and part of the purulent matter was brought up by coughing; but in the other four cases, there was no proof that the cells of the lungs, or the branches of the trachea, communicated with the cavity of the pleura. In all these cases, the pleura was opaque, and its thickness increased.

Although these persons had been long treated with neglect, and were deeply hectic before I saw them, yet all of them were relieved by the operation of paracentesis, and survived it a number of weeks. Those two of them, in whom the greatest quantity of matter had been collected lived the longest—one of them three, and the other five months; and this last was gradually gaining flesh and strength, but unluckily, by riding to a market, and exposing himself to cold and wet, he relapsed into an inflammation of the chest, and died in a few days thereafter.

Partial adhesion of the pleura pulmonalis to the pleura costalis, often is detected by dissection, when thee had been no previous disease of the chest which required bleeding, or confinement, and that the lungs seemed to be sound in other respects.

4. In some but rare cases, persons, from exposure to cold and other causes, have been suddenly seized with violent pain in the side, greatly increased on inspiring, with a quick and hard pulse, heat and thirst, without great sense of suffocation; and after their death the pleura costalis has been found not only glued to the pleura pulmonalis, but both have been observed to be thickened, and much indurated. In one case I found them ossified, yet the cellular part of the lungs appeared to be little changed.*

5. Where an inflammation of the thorax is brought on suddenly, by exposure to cold, wet, and such like ordinary causes, the first attack is often succeeded by a sense of difficult breathing, arising not merely from pain in the side in making the effort of breathing, but from a sense of suffocation, which forces the patient to start up and sit erect in bed leaning forwards; and whilst the patient gasps for breath, he complains of a deep-seated soreness in his

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* MORGAGNI, Ep. xxi. 38, writes as follows:—"Observationes ampliorum, graviorumque, illæso pulmone, pleuræ læsionum, in pleuritide non negamus; sed oppido perraras. esse dicimus." He quotes Coiterus, Servius, Gagliardus, and Valsalva, as affirming the same thing.

chest, and he is attacked with a frequent tickling cough, which is at first dry, but becomes moist by degrees ; and, in many cases, the clear part of the expectoration is streaked with blood. In one case a patient expectorated for several successive nights a tea-cupful of fibrine, slightly tinged with blood. At first the pulse is generally frequent and full, but if the breathing continues to be much oppressed, the pulse becomes softer, or weaker and irregular.

If, after these symptoms have continued for some days, the patient dies, the lungs are found to resemble the liver in their colour and consistence, to be heavier than usual, and in some cases to such a degree as to sink quickly in water, of which I have seen various instances.*

On examining them carefully, I have found in some cases, where the disease had made a rapid progress, that they were of a purple or very dark colour, owing to an effusion of the general mass of the blood into the air vesicles and branches of the trachea.

If the symptoms of violent inflammation abate, whilst the frequency of the pulse continues, attended with heat, thirst, and difficulty of breathing, with shivering and sweating, an abscess is forming in the lungs, which at last discharges itself generally into the trachea.

6. In the scrofula of the lungs, from which the most common species of phthisis pulmonalis originates, we may observe, at first, a frequent pulse and tickling cough, with little pain, soon succeeded by an effusion of their saline matter, which is expectorated with the mucus from the cells of the lungs ; and this is accompanied with, or followed by, the effusion of the coagulating lymph into the interstitial cellular membrane, which connects the pleura pulmo-

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* These facts are mentioned by Fr. Hoffman, See t. i. p. 398. Morgagni, Ep. xxi. 20, describes the lungs indurated, and like the liver, and that the cells and branches of the trachea were filled, more or less, with the red part of the blood, conjoined with a polypus-like matter, produced by the fibrin of the blood.

nalis to the proper membrane of the lungs, and the lobules to each other.

The lymph effused and changed, in consequence of the irritable state of the vessels which pour it out, and acted on by the absorbent vessels, produces the appearance of tubercles, within which purulent matter forms, which, by the wasting of the solid substance of the lungs, makes, at last, its way into the air cells and trachea.*

7. Both in the *true* pneumonia attacking suddenly, which may be called the *acute* pneumonia, and in the *scrofulous* pneumonia, which may be not improperly denominated the *chronic* pneumonia, the lung only of one side, or one of its lobes only, is attacked. Just as in the common cynanche tonsillaris, the inflammation occupies one only of the amygdalæ.

8. In the cynanche trachealis, or croup, the internal membrane of the larynx, and that of the trunk and large branches of the trachea, are chiefly affected.

9. But where the lungs are directly affected by contagious matter which the air conveys, as in the measles and chincough, all the branches and all the air vesicles of all the lobes, are uniformly affected.

10. Hæmorrhage from the lungs recurs frequently in some persons, without acute pains in the sides of the chest; and the hæmorrhage is preceded by a sense of heat and

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* Inflammation excited by pouring mercury into the windpipe of an animal gives rise to tubercles, as shewn by the experiments of Dr Kay. "The first rabbit," says Dr ALISON, "was killed eight days after the introduction of the mercury; and it is singular that the appearance of clusters of tubercles was more distinct in this than in any of the others. These lungs are preserved, but the colour of the tubercles does not now contrast with that of the pulmonary substance as before the lungs were put in spirits, and several of the clusters were destroyed in examining them minutely. The appearance of several of the clusters was so exactly that of tubercles in their early stage, that my learned colleague Dr MONRO, and several other friends, gave them that name without hesitation, before they were aware how they were produced; but on cutting into them, each contained in its centre a minute globule of mercury."

soreness within the chest, oppression in breathing, and a frequent and full pulse ; which prove that the hæmorrhage is produced by an increased action of the bloodvessels of the air-cells of the lungs.

11. In asthma, the muscles of the larynx, of the trachea, and bronchi, are evidently spasmodically affected ; and the muscles of respiration, particularly of expiration, seem to be similarly contracted.

The above facts shew, beyond a doubt,—

In the first place, that, in different cases, particular parts of the thorax are chiefly or solely inflamed.

2*d*, That the inflammation often spreads suddenly from one part to another ; and that authors appear to have employed very properly the term pleuro-pneumonia to express an extensive or general inflammation of the lungs and pleuræ.

In the third place, the seat of inflammation in the thorax is, in many cases, very distinguishable by peculiar symptoms.

(a) Thus, in several cases of inflammation of the pericardium and heart, I have observed that the pulse was full, hard, frequent, and irregular, and that the patient suffered a greater degree of pain and oppression, and these more increased by motion, than in pneumonia ; at the same time, there was little coughing, and he could inspire pretty fully without exciting much pain or coughing. The veins of the face, and lips, and tongue, had less of a livid hue than in pneumonia, in which a proper quantity of air cannot be drawn into the cells of the lungs to purify the blood.

(b) Thus, also, the symptoms in the inflammation of the pleuræ, described above in No. 4, differ essentially from those which occur in the acute pneumonia, which are enumerated in No. 5.

(c) Upon more accurately comparing the symptoms and appearances after death occasioned by pleurisy, described in No. 4, with those described in No. 5, it is, I apprehend, in the first place, beyond a doubt, that the pneumonia vera of authors, or acute pneumonia, does not begin in, nor is it

chiefly seated in, the pleura at large, nor in the pleura pulmonalis, as Dr Cullen and others have contended,* but in their parenchyma, as it has been called, or in their substance and membranes which line the trachea and bronchi, and which form the membranous tubes and the air vesicles of the lungs.†

In the next place, Dr Cullen not only entertained this erroneous opinion as to the general seat of the inflammation in pneumonia, but likewise misunderstood the chief cause of the fatal termination of this disease. To shew this, I shall quote his own words.

In vol. v. p. 239, § cclix, his words are :—

" There are, however, some other terminations of inflammation not commonly taken notice of, but now to be mentioned. One is, by an effusion of a portion of the entire mass of blood, either by means of rupture or anastomosis, into the adjoining cellular substance. This happens, especially in inflammations of the lungs, where the effused matter, by compressing the vessels and stopping the circulation, occasions a fatal suffocation ; and this is perhaps the manner in which pneumonic inflammation most commonly proves fatal."

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* Dr Cullen, in his first lines, vol. I. p. 311, par. cccxl, writes as follows : " To me it seems probable, that the disease is always seated, or at least begins, in some part of the pleura, taking that membrane in its greatest extent," &c. And, vol. I. par. cccxliii, p. 313, " It seems probable, that every acute inflammation begins in membranous parts," &c.

† The foregoing sketch of the inflammatory affections of the chest, seems principally intended to controvert the doctrines on the subject propagated by Cullen, as thus expressed in the first paragraph of his chapter of Pneumonia :—" Under this title (says he) I mean to comprehend the whole of the inflammations affecting either the viscera of the thorax, or the membrane lining the interior surface of that cavity ; for neither do our diagnostics serve to ascertain exactly the seat of the disease, nor does the difference in the seat of the disease exhibit any considerable variation in the state of the symptoms, nor lead to any difference in the method of cure." Dr Monro secundus brings forward the following arguments, which warrant him in dissenting from this opinion : 1*st*, He appeals to Morbid Anatomy, and distinctly shews, that particular tissues, the cellular membrane, the pleura, or the surface of

In vol. I. p. 316, § cccxlvi, he writes:

"The pneumonia, like other inflammations, may terminate by resolution, suppuration, or gangrene: but it has also a termination peculiar to itself, as has been hinted

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the lungs, are exclusively, or, at all events, principally, affected; the others remaining exempt.—2*d*, He connects those morbid appearances with the symptoms observed to accompany them during life, and shews that each has its characteristic signs.—3*d*, He proves that the treatment should be adapted to the tissue considered to be affected, and points out the danger arising from an imperfect diagnosis.

Our present knowledge of the origin, seat, and symptoms of diseases of the chest has confirmed the accuracy of many of his views, and has likewise shewn, that here and there he has fallen into error; but we must bear in mind, that, at the time he wrote, auscultation, to which principally we owe our present knowledge on this subject, was unknown, and the pathology of phthisis, so fertile a source of mistakes and mystery, was likewise unravelled; and when we bear in mind the weight of Dr Cullen's opinions, his talents, and his great experience in practice, we must form a high opinion of Dr Monro's powers of observation and reasoning, when we find him, in opposition to the greatest living authority, pointing out the errors of the prevailing doctrine, and substituting views of his own, which we now know to be so much nearer the truth.

It is interesting to look back upon the doctrines of our predecessors on diseases of the chest; and, at the same time, it is satisfactory,—for in no department of pathology has our knowledge acquired such additions, and we are enabled to point out their mistakes, to shew the cause of them, and to give the proper solution of the problem.

One of the most fertile sources of error was the accumulation of fluid in the cavity of the pleura. 1*st*, Hydrothorax, so long erroneously considered as an idiopathic disease. 2*d*, Empyema, the different sources of which were not known. Of this, we have a striking illustration in the six cases of paracentesis thoracis, of which Dr Monro makes mention. He was certain of the effusion of a fluid in the cavity of the pleura, he says, "from feeling in all, and from hearing in some of them, the undulation of the matter." "In two of the cases," he adds, "air was mixed with the purulent matter discharged by the wound, and a part of the purulent matter was brought up by coughing." He does not say that those were the cases in which the undulation of the matter was heard in the chest; but we now know, that, in such cases, it should have been, and might have been, heard: they were evidently, in short, cases of pneumo-thorax, owing, in all probability, to the perforation of the pleura pulmonalis by a tuberculous abscess, and, consequently, unfit cases for the operation of paracentesis. This origin of empyema was at above (cclix), and that is, when it is attended with an effusion of blood into the cellular texture of the lungs, which, soon interrupting the circulation of the blood through this viscus, produces a fatal suffocation."

Instead of assenting to the above opinions, it appears to me evident, that the great difficulty of breathing and sense of suffocation ; frequent cough ; moist expectoration, often tinged with blood, fluid florid blood, mixed with air, or clotted blood expectorated ; the indurated state and increased weight of the lungs, found in those who die of the disease, with the *livor* of the countenance which precedes death, clearly prove that the inflammation is in the substance of the lung, or in the membranous tubes and air-vesicles, and that the patient is suffocated, not because the suffused matter compresses the bloodvessels, and stops the circulation through them, but because the air-vessels are

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that time unknown, as well as the fact, that it is only when air, as well as fluid, is effused into the cavity of the chest, that the splashing of the fluid is heard. The origin of empyema from inflammation of the pleura was alone recognised, and the operation was proceeded to, to avoid the pressure upon the lung, and the danger (almost imaginary) of its becoming ulcerated by the accumulated matter: upon which principle was explained the presence of air sometimes (as in the two cases above) found along with pus.

Dr CULLEN regarded expectoration as a favourable symptom of the disease, a species of critical evacuation; whereas, Dr MONRO regards it as a measure of the severity of the disease; and, when the patient's strength is much exhausted, as a source of danger, by choking up the air passages and suffocating him. He points out what he calls the erroneous, and often fatal, rule laid down by some, that bloody expectoration ought to be promoted, instead of being checked; acting upon which rule, they have been deterred from bleeding: and, on the other hand, he earnestly urges, that, in all such cases, venesection should be actively employed. Upon the whole, imperfect though the sketch be, we recognise throughout it acute observation, sound logic, and practical sagacity; and it bears the stamp of proceeding from a master-mind, in not following blindly the prevailing doctrine of the day, but in being in advance of the state of the science at the time when it was written.

filled by the effused blood, and the access of the vital air to the circulating blood prevented thereby.

It is of the utmost importance that practitioners have the full conviction that the pneumonia is seated, not in the external membrane, but in the cellular substance of the lungs, because, in this disease, as the pulse is often soft and the degree of pain sometimes inconsiderable, especially in elderly persons, they are apt to neglect early and free bloodletting, on which chiefly the recovery of the patient depends; and, instead of it, to substitute blisters, with opiates for quieting the cough; and I will venture to allege that blisters have less effect here than has been generally supposed, and the reason is, that they do not act on the pulmonary vessels, but on those of the aortic system.

Another common error in such cases, sanctioned by high authority, is, that when the physician observes his patient begin to expectorate mucus tinged with blood, he is too apt to consider this as a salutary critical discharge, and to conclude that farther bloodletting would be improper and very hurtful, as it might interrupt this. Whereas, although it is evident that, where lymph or blood is effused into the cells of the lungs, it is much better that these should be expectorated than retained; yet the danger of suffocation from the effusion is so great, that, instead of desisting from venesection when bloody expectoration begins to appear, it should be laid down as a general rule to perform it without delay, unless the patient's strength be much exhausted. And in various such cases the detraction of blood has afforded such great relief, that I am convinced his recovery depended upon it. On the other hand, I have been called to various cases, where the surgeon had delayed venesection, in expectation of relief from bloody expectoration; but instead of this the difficulty of breathing had increased greatly, and was not afterwards relieved by venesection, because, as I supposed, the blood or lymph was now effused in great quantity into the cells of the lungs, and had clotted and prevented the proper entrance of the air into them, so that the patients sank with evident marks of suffocation.

To shew that relief from bloody spitting is not to be so much depended on as many have taught, Zeviani tells us, that, of seventy patients, one-half recovered without spitting; one-half of the remainder, who all expectorated, died.

Upon the whole, we ought, in my opinion, to consider spitting of blood as being generally a proof of a more dangerous degree of pneumonia.

In such cases, authors in general appear to have been deterred from bleeding by the fatal event which they have seen to follow it, without being aware that this was to be imputed to their own ill-judged delay in letting the blood; and that the disease would have proved fatal, although venesection had not been performed. Hence, I have no doubt, many have been deterred from performing the operation in proper time, and laid down the erroneous, and often fatal, rule, that bloody expectoration ought to be promoted instead of being checked.

They farther allege that venesection would, in this state, occasion farther effusion by relaxing the vessels, without considering that the effusion often depends, not on relaxation, but an increased action from irritation.

It is not only of great utility in practice to know, that although, in the true pneumonia, where the air-cells of the lungs are affected, the pain is less and the pulse softer than in pleurisy, that the danger is greater; and that speedy and copious and repeated venesection are more necessary; but we have further to observe, that, in the true pneumonia, the steam of water or vapour from medicines or different gases may reach the internal part of the lungs, which is chiefly affected, the effects of which, therefore, may be of material service, and particularly, perhaps, that these may counteract the bad effects of cold atmospheric air on the inflamed bloodvessels of the air-cells. On the other hand, that external fomentations, scarifying and cupping the containing parts of the thorax, or applying blisters to it, may be of much more essential service in pleurisy than in pneumonia, as they directly affect the branches of the vessels and nerves which are in the inflamed state; or, we perceive that the remedies vary according to the seat of inflammation.

Further, it must surely be admitted, that the surgeon, before he can perform his operations, should, by attention to the symptoms and progress of the disease, be enabled to determine whether purulent matter, formed in consequence of the previous inflammation, be lodged on the outside of the pleura costalis, or within the cavity of the pleura; or between the pleura pulmonalis and proper membrane of the lungs, on the outside of the lungs, or within the substance of the lungs. Upon the whole, we are left to conclude, that ascertaining the particular seat of the disorder may be of great use in pectoral diseases.

Of the Chirurgical Treatment in Empyema of the Thorax.

The empyema may be distinguished from hydrothorax, by previous symptoms of inflammation and suppuration; by a heat and quickness of pulse remaining; shivering, followed by colliquative sweating and emaciation.

On examining the bodies of those who have died from empyema, the matter has, in various cases, been found viscid and yellow, and yet no marks of erosion or ulceration appeared; in other cases, the matter had formed within the lungs, and, by an erosion or rupture of these and their investing membranes, had got into the cavity of the pleura, so that air was mixed with the pus; in some cases, the matter had formed on the outside of the pleura costalis, and, by occasioning a wasting or erosion of it, had made its way into the cavity of the pleura.

In all such cases, and even where the lungs are without tubercles, the disease must be highly dangerous; and the surgeon should be very guarded in his prognostic.

At the same time, it is evidently his duty, to give his patient the chance of recovery, by letting out the purulent matter, or he ought to perform the operation called the paracentesis of the thorax, because they generally make a perforation with a trocar. But although this seems to be the best instrument in the case of hydrothorax, or where the lungs are entire, and no air mixed with the purulent matter, yet we ought, in cases where there is a quantity of pus, rendered perhaps putrid by the mixture of air, instead of using a trocar, to make an incision, because for the cure, a free discharge of purulent matter, for a length of time, is necessary.

Upon the whole, I think it will be best to begin with the paracentesis, and if the matter is putrid, or that, after the puncture, it shall not be freely discharged, an incision should be made. I have directed this operation to be performed in six different patients, and I shall now describe and shew you what I apprehend to be the best way of examining the case, and operating in it.

The patient ought to be seated ; and a strong person, who understands the nature of the disease, ought to stand behind him, and hold fast the shoulders of the patient, and then agitate, at the same time bending his body, by sudden jerks ; first from side to side, and, afterwards, backwards and forwards. The surgeon is, in the mean time, to apply his two hands at once first to the opposite sides of the thorax of the patient, and afterwards to the fore and back parts of the thorax.

As the lungs of the patient contain the compressible air, they yield to the impulse of the purulent matter, which therefore strikes the sides, or fore and back parts of the thorax with force, or a shock or impulse is given, which is distinctly to be felt by the hands of the surgeon. A sound is likewise in some cases perceived, but the surgeon is not to trust to that *alone*, because I know he might be deceived by the motion of fluids contained in the stomach of the patient.

Some physicians, either from having met with an uncommon case, or from mere speculation, talk of the great hazard of agitating a person whose breathing is oppressed by disease, and deter the surgeon from trying an experiment altogether necessary, before he can, with any degree of safety, perform his operation; for, before he does it, he should mark, with ink, the place at which the matter strikes the thorax, as he is assured by the shock that the lungs do not adhere there.

Having discovered, by the feel, the safest place for performing the operation, and marked it with ink, the patient ought to be laid in the horizontal posture on the edge of a bed. The surgeon is then to perform the paracentesis, as in the case of hydrothorax: or if the incision seems preferable, he is to make his incision, cautiously, parallel with the ribs, and nearer to the under than the upper part of the rib, or as far as possible from the trunks of the intercostal vessels and nerves, which are lodged in the furrow in the lower part of each rib.

An incision about two inches in length should be made through the skin, after which, the external muscles are to be divided, and the serratus anticus major generally falls in the way. More caution is necessary in cutting the two layers of the intercostal muscles; and a still greater degree of it in puncturing, and then on a directory, making an incision in the pleura.

After dividing the pleura, the patient is to be turned over, so as to make the hole in the pleura the lowermost part of the thorax, that the whole of the purulent matter may be evacuated: and although, in the several cases I attended, from two to six pounds of matter were discharged, and in one case about thirty pounds, none of the patients were thrown into a faint, or otherwise dangerous situation.

The patients are less affected by evacuating the matter, than, at first sight, might be supposed, owing chiefly to two causes; the first is, that before the operation, the lungs were as much compressed by the matter, as they are by the air which is admitted ; and the other is, that, generally, they are supported, in different places, by partial adhesions of them to the containing parts of the chest.

The best and safest way of dressing the wound is to cover it with a broad piece of linen rag, that no part of the dressings may get into the cavity of the thorax ; and on the outside of this, over the wound, to lay on some charpie to keep the sides of the wound from uniting too soon, and over it a linen compress, supported moderately by a broad flannel bandage, which is not to be drawn so much as to prevent the free discharge of the matter ; and to promote this the patient should rest much on the affected side.

After the operation, the patient ought to be laid on the diseased side, to give more free vent to the matter, and that the motion of the ribs of the sound side may not be resisted by the weight of the body.

Where purulent matter or water are collected in a shut cyst, whether this is within the substance of the lungs, or between the pleura pulmonalis and pleura costalis, the fluctuation of the liquor is generally not distinguishable, even though the size of the cyst be considerable—so that we can judge of its presence only by the preceding signs of inflammation in the part; and that the teguments, over the sac, become thick and œdematous.

Treatment of an Abscess in the Substance of the Lungs.

Sometimes, after a fixed pain in the side, attended often with thickening of the skin and external parts, the patient discharges by coughing, in the space of a few minutes, a great quantity of purulent matter ; from which it appears probable, in the highest degree, that there is a large abscess near the surface of the lungs, and also that these adhere to the side.

In such cases the patient will probably have a better chance of recovering, if an opening be made in the side of the lungs, at the lower part of the abscess. In one such case, in which I was consulted along with Dr Gregory, we directed an incision to be made. The operation was executed by the late ingenious Dr Menzies, and nearly two pounds of matter were discharged at the wound; but the lungs were otherwise too deeply affected to admit of a cure.

Where we discover, by the preceding symptoms of inflammation and suppuration, followed by thickening of the teguments, œdema, and by the fluctuation of a liquor, when the fingers are applied to the side, that purulent matter has collected on the outer side of the pleura, we ought, without delay, to discharge it by an incision, lest it should burst into the cavity of the chest.

In scrofulous cases, especially, purulent matter is apt to form in the anterior mediastinum. Whether it begins in the lymphatic glands or cellular substance of the anterior mediastinum is uncertain. With time it erodes the sternum, or breaks out at its edges; and when this is observed, it ought to be the business of the surgeon to give it a free outlet, lest it make its way laterally into the cavities of the pleuræ, and, in doing this, let him recollect that the mediastinum is nearer to the left than to the right side of the sternum.

Chirurgical Treatment, where Blood is effused into the Pleuræ.

If, in consequence of a wound of the chest by a bullet, a sharp-pointed weapon, or fractured rib beat inwards, a person becomes suddenly pale and faint, with a feeble pulse, and oppression in his breathing, we may conclude, with great probability, that a considerable artery of the containing parts, or of the lungs, has been cut or lacerated. If he brings up blood by coughing, we learn that the lungs are wounded, and that the effusion is, in part, into their cells. If the paleness, faintness, and feeble pulse continue, but the coughing up of the blood ceases, or becomes inconsiderable, it is probable in a high degree that blood has been likewise effused in considerable quantity into the cavity of the pleura.

In these circumstances, many authors have directed an incision to be directly made into the cavity of the thorax, in order to discharge the blood. But as the blood mixed with the air clots, and therefore could not easily be got out, and as such an operation cannot be executed without exciting violent and highly dangerous inflammation of the lungs, as well as of the containing parts, and that I have found this prove fatal to quadrupeds, I would recommend to you to watch the consequences of the accident, and to give the patient time to recover somewhat from the shock he has received, and to get the chance of the blood being absorbed, and not to operate till it appears from the symptoms that the effused blood, instead of being absorbed, has corrupted, or that purulent matter has collected within the chest, and that the life of the person cannot be saved without a puncture or incision into the cavity of the thorax.

SECT. I. *Of the Effusion of Air from the Lungs into the Pleura.*

The effusion of air from the lungs into the pleura may happen,

1. If the lungs are wounded obliquely, by a sword or other pointed instrument,* the air escaping from them into the pleura, may, in consequence of the obliquity with which the instrument has entered, neither get back by the windpipe, nor escape by the external wound, but may be accu-

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* Mr HEWSON attempted to produced emphysema artificially, by wounding the lungs of dogs and rabbits in different ways, but without success; which leads to the conclusion that emphysema is rarely produced (though the contrary has been asserted on high authority) by a puncture with a sharp body

mulated and even condensed within the pleura, and compress the whole substance of the lungs on that side.*

2. The point of a fractured rib, beat inwards so as to wound the lungs, may, it is evident, produce similar effects, and in fact has been the most frequent cause of the effusion.

3. A violent fit of coughing or over exertion of the voice, may produce a rupture of the lungs, of which I met one case with Dr Meckel at Berlin in 1757, of which the Doctor published an account. And this would probably happen frequently, if the lungs and their investing membranes were not supported by the ribs and other containing parts of the thorax ; just as a thin bladder inflated and inclosed within a strong leathern bag, and used as a foot-ball, is not burst by the violent blows it receives.

4. In some cases, not only the lungs and the pleura pulmonalis, but likewise the pleura costalis, have been ruptured by such efforts.†

Where the pleura costalis has been wounded or ruptured in such cases, the air effused from the lungs, condensed by the efforts of respiration, and rarefied by the heat of the body, compresses the lungs in the first place ; and if it afterwards escapes through the hole in the pleura costalis, which generally happens, produces an emphysema ; which sometimes extends, in the subcutaneous cellular membrane, over a great part of the body ; and is distinguished by the swelling it occasions, and by the crackling which is heard, when the swelled parts are handled.

Where the wound in the pleura costalis is small, and has been made in an oblique direction, the air effused from the lungs into the pleura may not find a passage outwards, and therefore may compress the lungs greatly ; or the compression may be as great in this case, as where the lungs are ruptured by an effort, without any outlet or rupture in the pleura costalis.*

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* Emphysema also sometimes occurs from a rupture of the larynx or windpipe, occasioned by a blow or kick. Vide O'Brien, Edin. Med. and Surg. Journal, No. 72.

† Of this Dr Monro secundus met with one instance in 1769, and Dr Alexander Hamilton told him after this, of a second case which happened to a young woman during child-bearing; and in Medical Tracts, published in London 1791, a third case is mentioned.

Many cases of emphysema, which have proved fatal, are mentioned by authors.

In some of these, the accident producing the emphysema had perhaps injured the bowels of the thorax so much, that life could not be saved. But, in others, it is evident the patients narrowly escaped,† or were lost,‡ because surgeons were not aware that the danger arose from the compression of the lungs, and had not thought of taking off the pressure of the air on the lungs by perforating the thorax.

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* The symptoms of emphysema of the lungs and cellular tissue, which are not increased by a full inspiration, are pain, difficulty in breathing, a sensation as if a cord was tightly drawn across the chest, and an elastic swelling, which very rapidly increases, and is speedily diffused over the chest, neck, face, eyelids, and body in general. In some places the skin is elevated from the bones and muscles several inches, that the ribs can neither be felt or traced; and on pressure, the skin, which has a shining surface, crackles, and the air may be pressed from any part, so that the swelling is removed. The inflation is great and universal, except in the hands and feet, where it is inconsiderable. In short, the degree of swelling varies in different parts of the body, being proportioned to the extent of the cellular tissue; and the body, when struck, sounds like a wet drum. In a short time the breathing becomes very laborious and quick—the patient is unable to lie on either side, pulse becomes irregular, and the extremities cold, which is followed by suffocation. There is another and very rare kind of emphysema, which has been called the *Spontaneous*. It has been particularly described by Dr BAILLIE (*Vide* vol. 1. of Transactions of Medical Society of London)—a great deal of air was effused under the skin—the patient, a girl, died in two days—air was found in the thorax and abdomen, and also a considerable quantity of water. The air had not escaped into the cellular membrane, in consequence of the lungs having been wounded by a broken rib; nor was it generated by putrefaction, as takes place in mortification.

Mr ALLAN BURNS of Glasgow, in his excellent book on the Surgical Anatomy of the Head and Neck, p. 52, has also described this kind of emphysema. Air was detected within the heart and bloodvessels in this case—no communication could be discovered between the air-passages and the tumour in the neck, which was of five years' duration.

† As in the case treated by Dr WILLIAM HUNTER in 1751, and published in Med. Obs. 1762.

‡ As in cases described by Messrs LITTRE, M. de l'Acad. 1713, and by CHESTON, Path. Obs. 1764, and in a case communicated to me by Mr SCOTT of Kelso in 1781.

From speculating on the subject, soon after I began to study, I was led to think of the way of relieving the patient by an operation. A case occurred at Berlin, which I examined along with Dr MECKEL, and of which he afterwards published an account, which I apprehend shews, in the clearest manner, the fatal effects which the compression by air, though of one side only of the lungs, may have.

In this case* a soldier, 18 years of age, had been suddenly so much oppressed in his breathing, without a known cause, that he could not lie down in bed for four months before his death. On opening his abdomen, the liver was observed to be much lower than it is usually; and on cutting the diaphragm a blast of air was discharged. On laying the thorax fully open, the lungs on the right side were found collapsed, indurated, and their lobes adhering to each other, and to the pleura costalis.

The knowledge of the cause of the dangerous symptoms at once points out the means of relieving the patient, by discharging the air from the cavity of the pleura: and in 1769 this operation was first proposed and performed by my direction.†

I shall now proceed to explain the steps to be taken by the surgeon.

Although the oppression felt by the patient proves that the lungs are in a collapsed state, and have little connection with the containing parts, yet that we may more certainly avoid puncturing them, where there may be an adhesion of the lungs to the pleura, the surgeon ought to find, if possible, the place at which air has got out to form the beginning of emphysema, as there will be no adhesion there, or this will be the best place for the perforation. It is necessary, on a still more important account, that the surgeon should ascertain in what place and on which side the lungs have been wounded or ruptured, because if he should mistake the side, which might happen readily from the air passing in the cellular substance to the sound side, the patient, instead of being relieved by a puncture, will be suffocated by it, as the sound lungs will collapse in consequence of the admission of the air by the puncture, whilst the lungs on the ruptured side will be compressed by the air which has been effused into the cavity of the pleura.

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* See M. De l'Ac. du Berlin, t. 15, 1759. It did not occur to Dr MECKEL that the paracentesis of the thorax might have saved this patient.

† See an account of this cure and the operation performed, in the Med. Com. published by Dr DUNCAN in 1774, v. 2.

As the danger in such cases arises from the compressed or collapsed state of the lungs, it is so evident that a large aperture into the cavity must, independent of the pernicious effects of the air, cut off every chance of recovery.

The perforation is to be made with a small-sized and round trocar, which, in the event of its falling in upon some part of the lungs, does not so readily cut the branches of their bloodvessels.

The trocar is to be entered like a drill, slowly and cautiously, and obliquely, that, on withdrawing it, no communication may remain between the atmosphere and cavity of the pleura.

As the canula of a trocar is made thin, in order that it may readily follow the perforator; and as of course the edges of the end of it are sharp, we should be provided with a blunt canula, to be substituted instead of it, and to be left within the thorax so long as air continued to be discharged from the wound in the lungs.

The blunt tube we introduce ought to have a broad head or shield, by which it may be fixed to the body of the patient.*

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* This apparatus is represented in my book on the Bowels of the Pelvis, Plate 3d, figs. 1, 2, 3.

That the air may not be continually passing to and fro in respiration, a plug is to be fitted to the tube, which may be occasionally withdrawn.

When the air is no longer discharged from the lungs, or the wound in them is healed, the air should be sucked from the cavity of the pleura, before the surgeon withdraws the tube: and an elastic bottle is the most fit instrument for that purpose.

The above operation should only be performed when the lungs are collapsed and compressed to such a degree as occasions immediately dangerous symptoms; for it happens, perhaps not unfrequently, that, by the fracture of the ribs, the lungs are wounded, and a subcutaneous emphysema produced, yet the patient is little oppressed, probably because the lungs of elderly persons are mechanically supported by adhesions they had formerly contracted with the containing parts of the thorax.

The two following cases, to which I was called along with Mr Eb. Clarkson, surgeon in Dalkeith, appear to have been of this kind.

Case I.—On June 7. 1782, Mr G——, about sixty years of age, fell from horseback on the stump of a tree, and fractured the fourth and fifth ribs of his left side, near their joinings with their cartilages. A subcutaneous emphysema appeared very soon after the accident, attended with some oppression in his breathing.

I saw him, along with Mr Clarkson, about four hours after the accident.

We let him blood immediately, but not finding that his difficulty of breathing was considerable or increasing, or that the emphysema was spreading, we neither cut the skin nor perforated the pleura.

His difficulty of breathing and emphysema went off gradually; his ribs were reunited in the ordinary time, and his recovery was in all respects complete.

Case II.—On August 5. 1795, I was called, by Mr Clarkson, to a similar case of a miner of the name of

Johnstone, who had two ribs, about the middle of his left side, fractured by an iron crow which had fallen upon him from a great height. In this case, there was an emphysema about ten inches in diameter between the skin and the fracture, and his breathing was oppressed, but not to so great a degree as to render the paracentesis of the thorax necessary. We bled him freely, recommended rest and a cooling regimen, with the application of a flannel roller, by which he gradually recovered.*

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* I had occasion to see, along with Dr Wardrope of London, emphysema of the chest, which was occasioned by a wheel grazing across the chest. The air extended over the right side of the chest, and the swelling was soft, elastic, and communicated a crackling sensation, occasioned by the air collected in the cellular tissue.

Blood was drawn, a purgative given, and a double-headed roller was applied around the chest, in order to prevent the motion of the ribs during respiration. By these means, the patient recovered in a few days.

To the valuable Treatise on Emphysema of Sir Andrew Halliday, London 1807, the reader is referred for more full information.

Besides this species of Emphysema above described, there is partial Emphysema of the Lungs, limited in one instance to part of one of the lobes, and most frequently to the thin edge of the lobe.

When these cavities containing air, *called Bullæ*, are examined with care, they are found to consist of a number of air-cells, the partitions between which have been broken down, and the cells on the surface are invariably larger than those which are more deeply seated in the substance of the lungs.

The bloodvessels in the vicinity of these bullæ are generally like those in the vicinity of an abscess of the lungs considerably contracted. The bronchi are sometimes much enlarged, and are very vascular. The symptoms are,—difficult breathing, paroxysms of cough, palpitation, œdema of the lower limbs; face swollen, lips are livid, and veins of neck are turgid; on percussion the chest is sonorous, owing to the air distending the bullæ, weakness of the respiratory murmur, owing to the debility of the muscles of inspiration.

The palpitation and enlargement of the heart are the effects of the obstruction opposed to the circulation of the blood through the lungs.

ESSAY IV.

ON THE STRUCTURE AND ON SOME OF THE ORGANIC DISEASES OF THE CIRCULATING SYSTEM.*

THIS very important part of the animal fabric attracted a large share of the attention of Dr MONRO secundus. He investigated with the most minute attention the structure of the walls of the heart, the different coats of the arteries and of the veins, the course and anastomoses of the ramifications of the arteries, the peculiarities of the circulation of the blood within the skull, which he described at length in his book on the Nervous System, and also the organic disorders of this system, for the study of which last Edinburgh holds out peculiar advantages, on account of the number of victims of such disorders.

Dr MONRO secundus directed his peculiar attention to the structure of the human heart, and that of several of the amphibia and fishes, and to the number, relative magnitude, and situation of the different cavities proper to that very important organ. He traced, with very great care, the arrangement of the muscular fibres, a subject of great intricacy and difficulty, and which has led to very different results in the hands of Cowper, Wolff, Lower, and Dr J. Reid,* who have laboured in the same vineyard.

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* In the following Essay an extract only is given of the opinions of Dr MONRO secundus on the circulating system; as the printing of his observations in full on this important subject, and on the connexion between the circulating and other parts of the animal economy, would have filled a large volume. It may suffice to observe, that there is a most intimate relation between the organs of circulation and respiration, and also a great difference as to the rapidity with which the blood of different classes of animals is exposed to the air; in general, the more rapid the supply, and the more frequently the blood is exposed to the air, the more energetic the vital functions; whilst, on the other hand, the more slowly the nourishment is supplied, and the less the blood is exposed to the air, the less energetic the vital actions are, and this is combined with greater tenacity of life.

There are a few points in which these different distinguished anatomists are agreed, such as the small size and intimate intertexture of the muscular fibres of the heart with one another, the direction of the greater number of fibres towards the apex of the heart, around which they describe a spiral course, and the continuity of the fibres of the auricles with each other, and the want of continuity between those of the auricles and ventricles.†

Dr Monro endeavoured to ascertain the comparative forms and capacities of the auricles and ventricles of the same, and of the opposite sides of the heart, by filling them with melted wax, and then destroying the flesh by an acid; this he did over and over again, notwithstanding which he did not obtain fully his object. All he ascertained was, the greater capacity and somewhat triangular form of the anterior ventricle, and the smaller capacity and oval shape of the posterior ventricle.

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* Cyclopæd. of Anat. and Physiol. by Dr Todd. London, 1839.

† The size of the heart is not proportioned to the size of the animal, nor to the strength of the pulse. I agree with Mr J. Hunter in the opinion, "that the size of the heart bears a compound ratio to the quantity of blood to be moved, and the frequency of the stroke it has to make, for where the quantity of blood is decreased, the frequency of the stroke must be increased;" hence, when a considerable quantity of blood is lost, the heart pulsates more rapidly and violently. According to Treviranus, the size of the heart, as compared with the whole body, decreases in proportion as the animal is lower in the scale of being.

The reader would do well to peruse with care the observations of Dr Hope on the motions of the heart, which occur in his very valuable book on the Diseases of the Heart, and also those of Drs C. J. B. Williams and Corrigan on the same subject; vide Transactions of King's and Queen's College of Physicians of Ireland (new series, i. 151).

Dr Monro secundus took great pains in dissecting the nerves of the human heart, and during the long period he delivered lectures, exhibited nerves entering into the muscular substance of this organ, as well as other nerves which follow the same course as the coronary arteries.

Berhends, however, has affirmed that the muscular substance of the heart is destitute of nerves, and published a book in support of his opinion. This book attracted, in an especial manner, the notice of Scarpa, and induced him to publish beautiful engravings of the nerves of the head, neck, and bowels of chest, in which he has with great fidelity represented the situation and course of the nerves of the heart.

Dr Monro secundus performed a number of experiments with opium upon frogs, to determine its effects upon the circulation of the blood. " I poured laudanum into the stomach, injected it into the rectum, and applied it to the skin, and in these instances, the animal became violently affected, and at length died.

" After observing the effects whilst the circulation and nervous power were entire, I endeavoured to ascertain how far these effects depend upon the nerves alone, or vessels alone. I cut out the heart, then applied the opium, in the way in which the animal can be most violently affected, by pouring it into the cavity of the abdomen, and found, that, in a very short space of time, the muscles of the most distant extremities of the body were rendered useless; a degree of motion remained, but it was convulsive, and the animal was so weak, that it was not able to crawl from the place where it was laid. So it appears evident, that all the nerves of the body may suffer by an application to a few of them; that there is such a connexion among them somewhere or other, that a single nerve injured, brings all the others to suffer in the most violent manner; or, that there is a sympathy among the nerves. But, on pouring the opium under the skin of the leg, in which the circulation was stopped, contrary to expectation, I did not find that I could communicate the injury to the rest of the system; the nerves in that part were immediately unhinged. As soon as the opium reached the muscles all motion was at an end, yet the injury was not communicated to the rest of the nervous system. This opens a view, that the accompanying vessels, in a manner we do not altogether understand, fit the nerves for conveying their impressions; it is not sufficient that the circulation remain free at the beginning of the nerves.

"I next cut the nerve of a particular part, leaving the bloodvessels free, viz. the sciatic nerve, issuing from the end of the spinal marrow; and to make sure work, I divided every thing, but the bottom of the aorta,—the vena cava, and probably the lymphatic vessels running on their coats; yet opium applied to the hinder extremities of the animal influenced the whole body, and in no very great length of time, in not much longer than when the animal was altogether sound. Though opium affects the body not merely by touching the nerves, *e. g.* taking opium into our stomach, we are by no means to conceive, that the sole influence depends upon the nerves of the stomach, and that the others sympathize; but we may be affected by opium entering the lacteals, and conveyed into the mass of blood; not that it in a mechanical way influences the hydraulic system, but the nerves of the circulating vessels are affected, and through these all the other nerves.

"To shew in some manner the possibility of this, I next opened a vessel near to the heart, and poured into it a small drop of the solution of opium; as soon as it touched the heart, that organ ceased from motion. Or I cut through the aorta, or opened it, to prevent the communication between the heart and the rest of the body, then dropt the liquor into the heart, and in a few seconds, the most distant parts were brought to sympathize, so that the nerves are affected in the distant parts by the affection of the nerves of the heart. So the opium introduced by absorption operates in a great measure in the like manner.

"Or to shew more clearly, again, that one nerve influences the most distant nerves, without conveyance by the circulating system, I may add another experiment.

"Laying bare the sciatic nerve of a frog, and touching it with the most minute drop of spiritus cornu cervi, that instantly deprived the nerve of its power; and I constantly found, that, though the animal be thrown into water, and the nerve washed, yet in a day or two thereafter it dies; and not of the mere injury done to the sciatic nerve alone, for when we burnt it with a hot iron, or cut it through, the parts of the nerve are even reunited, so that we can scarcely know the place; but the poison goes deeper into the nervous system, and the whole nervous system comes to be injured through this nerve.

"Now, after considering these effects of opium, I need scarcely insist on the effects of ardent spirits, or of essential oils, as camphor; only from the volatile nature of this last, we can observe that the smell is communicated to the most distant organs unchanged, and these organs put into water give the taste to the water; so that the animal is killed in consequence of the absorption of these medicines, as well as by their direct operation upon the nerves; or, upon the whole, we are very variously affected by medicines, or by the matter of disease acting upon our body; for, besides topical medicines, which scarcely affect the parts at a distance, medicines, by resting merely upon a single nerve, through the nerves alone can affect the whole system; or, from being circulated, they may have this effect, and chiefly upon the nerves of the circulating system. Farther, some medicines have a topical determination; one organ is more affected by them than another. All the rest of the system, however, though not primarily, comes to be affected in a secondary way, the particular organ primarily affected reacting on the rest. Thus, suppose mercury to enter the heart and vessels, these feel its influence, the pulse is affected before it fixes on any organ, and the venereal poison is killed floating in the general mass; but in consequence of its attacking a particular organ, all the rest may come to sympathize; so the operation of medicines, and still more of morbid matter, fermenting and multiplying in the mass, may be more complex than is generally apprehended."

See a full account of the above experiments in vol. iii. of the Literary and Physical Essays of Edinburgh.*

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* There are several sources by which great light is thrown upon the functions of the different organs of the body—by investigating the structure, and making experiments on the inferior animals—by noting the effects of malformation, and the symptoms occasioned by injuries and organic diseases. Thus, the circulation of the blood can be carried on without the heart, as in many of the inferior animals and in human monsters. The functions of the heart are deranged by injuries done to the brain and spinal cord, by severe injuries inflicted upon the extremities, as occurred in the very melancholy instance of Mr Huskisson, whose thigh was dreadfully mangled by a steam coach having passed over it; great prostration of strength and languid action of the heart followed, but no reaction took place. A leg may be amputated without loss of life, yet when a limb has been severely crushed, the heart sometimes ceases to contract. The action of the heart and bloodvessels is much affected by narcotic substances applied to the heart (as above mentioned), and even when applied to the skin or stomach, of which Dr Alston's beautiful experiment is a striking illustration. After injecting laudanum into the stomach of a frog, and subjecting the web of the foot to a microscope, he observes (speaking of the second time he made this experiment), " the blood then moved slower than it did the first time, and its velocity gradually decreasing, at length it stagnated." He adds, " notwithstanding the diminished velocity of the blood, there was no sensible diminution of the frequency of the pulse; yet, when there was no circulation or progressive motion of the blood in this part, the pulse was visible by an undulating motion." It may be added, that Dr Alston observed (Edin. Med. Essays, vol. v. 1.), " that the anodyne virtues of opium do not depend on its action on the brain or on the blood, whether externally or internally applied." The action of the heart and bloodvessels is independent of the brain, for, it is not suspended by decapitating a frog, as the animal continues to live during two or three days after that operation; and in the human monster, described by my father, the circulation had been carried on solely by the action of the bloodvessels, and without the influence of the brain, as there

Of the Agents by which the Blood is circulated.

Dr Monro secundus invariably contended that the blood is circulated by the conjunct agency of the heart, and of the coats of the arteries and veins; and in his opinion, that

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was no vestige of head; a fact also proved by the experiments of Dr Wilson Philip, the circulation being continued after the removal of the brain and spinal cord.

Lastly, very different effects follow applying laudanum partially or generally, and by destroying the whole brain or spinal cord at once, and in successive portions at different intervals. This fact, as to opium, my father used to illustrate by the following experiment:—He bored a hole in the part of the spinal column of a frog near to the hinder legs, after which he injected laudanum into the spinal canal. No effect was produced, but when he made another hole in the part of the spinal column in the vicinity of the head, and then injected laudanum at the aperture next the tail, so that it came out at the aperture in the spinal column next the head, by which the laudanum came into contact with a considerable part of the spinal cord, death immediately followed.

Dr Marshall Hall observes (p. 137 of his Essay on the Circulation of the Blood), "In fact, if a portion of the nervous masses be removed, and if this be compatible with life, the animal is reduced to a lower degree in the scale of organized beings. It lives as a still lower animal. And it becomes capable, on this principle, of enduring new privations. I doubt not that, in this manner, the whole brain and spinal marrow may be removed, and that the animal may live, sustained by the mere ganglionic masses, and the cutaneous respiration."

"The first part of these several experiments reduced the animal many degrees in the scale. In the first experiment it subsisted without medulla oblongata, or pulmonary respiration. Its nervous system was reduced; its respiration was merely cutaneous. In this state, it was enabled to endure the further and entire privation of its brain and spinal marrow, without the immediate cessation of the power of circulation. In the second experiment, the extent of the nervous system was lessened. The animal descended lower in the scale of beings, and became capable of bearing further mutilations.

"The extent of the circulation was not lessened, according to the idea of Legallois; for it was watched all along in the web. There was neither more nor less of crushing than in experiments in which the capillary circulation in the web speedily failed. The medulla oblongata was removed, without producing the effects observed by M. Flourens."

the latter had far greater influence than the former, the circulation being maintained in many of the inferior animals, and in some human monsters born without the heart. His arguments, upon which such an opinion is founded, may be seen in his description of a human monster, published in the Transactions of the Royal Society of Edinburgh. In the museum of Dr MONRO there are several preparations made by himself, which exhibit the muscular

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Various passions of the mind exert, a most striking effect over the action of the bloodvessels; by fear, they are constricted, and paleness ensues; but, on the other hand, by rage, they act with unusual activity, which causes redness and flushing of the face; and in the same manner, irritation applied, gives occasion to an increased flow of bile or urine, and occasionally even to a discharge of blood through the excretory ducts of these glands; and, on the other hand, palsy, or the division of the nerves proper to glands, diminishes the quantity of the secreted fluid of some glands, whilst that of others is increased; thus, by the division of the pneumogastric nerves, the quantity of the gastric juice is diminished; but, on the other hand, that of the mucous glands of the branches of the windpipe is increased, so as to occasion suffocation; and in the case of the kidney, according to KRIMER, renders the urine albuminous and alkaline, which is removed by the application of galvanism. 2d, Injuries inflicted upon the spinal cord derange the process of digestion, create a disposition to vomit, and what is discharged is very fætid. That injuries of the spinal cord produce a morbid state of the urine has been long known. SIR B. BRODIE's observations on this head merit peculiar notice (vide Med. Chir. Trans. vol. 20). According to his observations, the urine occasionally becomes very acid, and deposits a great deal of a yellow sediment, but at other times, it is distinctly alkaline. This morbid state of the urine is but of a few weeks' duration, after which it becomes limpid and acid. HUMBOLDT's experiment on his own person is a strong proof of the influence of the nerves on the secretions. He applied two blisters to his shoulder, covered one of them with a silver plate, and closed the circle by a zinc conductor, which produced a burning sensation, and the discharge, instead of being bland, became acrid and red. From what has been stated, it follows, injuries of the nervous system influence the functions of secretion, as well as the circulation in the small vessels, from which secretion takes place. It may be also observed, in evidence of the influence of the circulating and nervous systems on each other, that the deficiency or imperfect organization of different parts of the body bear a ratio to the deficiency or imperfect organization of the corresponding parts of the spinal cord.

coats of the femoral and humeral arteries, in which the muscular coat is much more apparent than in the main trunk; the blood being propelled through the aorta by the impulse communicated to it by the heart.*

The contractile power of the coats of the arteries has been proved by Dr Monro secundus, by a number of experiments made on frogs and salamanders.

" *Experiment* 1.—I applied pure spiritus cornu cervi to the foot of a frog, and which seemed to be much hurt by it; the whole foot was very red.

All the small arteries were redder and larger, and their communications with the veins much more visible than they are naturally.

The number of the small arteries did not seem to be increased, or I could not observe an *error loci* of the globules; but in the interstices of the vessels there was more than common yellowness, as if there had been an exudation into the cellular membrane of some part of the serum, perhaps mixed with some of the red part of the blood.

" *Experiment* 2.—On applying spiritus cornu cervi to the tail of a water salamander, the appearances were exactly the same as have been described in the last experiment.

" *Experiment* 3.—After boring the point of the tail of a water salamander, and the web between the toes of a frog,

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* Anatomists are by no means agreed as to the muscular power of the arterial and venous system, and hence it seems necessary to subjoin a few remarks upon this much disputed point. Harvey, Haller, and Spallanzani denied the muscular power of the coats of the arteries, an opinion which has lately been adopted in France. The fibrous or muscular coat differs in many respects, and is in others similar to muscles. The points of distinction are,—they differ in point of colour, they are not so red, but more of a yellow colour; they are flatter and drier, are divisible into layers; there is no cellular tissue between the fibres, and they contain no fibrin, according to Berzelius. But it may be replied, that all muscles are not precisely similar in colour, and that this coat certainly possesses the characteristic properties of muscles, a contractile power followed by relaxation; so that this seems to me to be rather a dispute about words than facts, as all admit that the arteries possess a power of altering their calibre, independently of a vis a tergo.

I examined the consequent inflammation for four or five days with the microscope. The redness seemed almost entirely owing to an extravasation of a bloody water, in which no globules could be observed, through which vessels carrying red globules passed, the communications of which with the veins were redder and more distinct than in other places, as these vessels were somewhat enlarged.

"*Experiment* 4.—The appearances were entirely the same three days after the medulla spinalis was destroyed from the middle of the back, or after all the crural nerves were cut.

"*Experiment* 5.—After the eschars made by the hot iron had separated, I placed the inflamed end of the tail of the water salamander before the microscope. I then touched it with spiritus cornu cervi. The vessels in the inflamed part* very soon became more distinct, or they were more distended with blood and larger; and then, the blood was poured forth from the mouths of a number of vessels upon the end of the tail, or from any part of the edges from which an eschar had separated.†

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* May not the morbid state of the blood of an inflamed part modify these appearances of the inflamed member? The blood is no longer globular; at first the blood is redder, and afterwards assumes a brown or yellow tinge, and when suppuration is established, according to GENDRIN, it resembles pus. If the inflammation be very acute, the blood no longer retains its red colour, it stagnates, and gangrene follows. The state of the nerves also causes inflammation, and may modify it and the appearances the inflamed part assumes; thus, if the fifth pair of nerves be divided, inflammation of the globe of the eye follows, and from gunshot wounds inflammation and mortification ensue.—Vide EARLE, Med. Chir. Trans. vol. 7, p. 173.

† The above observations of Dr MONRO secundus have been confirmed by the experiments of Mr J. HUNTER, Drs THOMSON, HASTINGS, and KALTENBRUNNER, and more especially by those of HUNTER, who, among other arguments, has observed, "that inflamed parts bleed more copiously than those which are uninflamed." The contractile power of the arteries and the striking influence of the muscular power in propelling, is obvious from the fact that arteries contract beyond a ligature, and even after the heart has been cut out, and that they are

The arteries are also contracted by the elastic reaction of their coats, and especially by that of the outer elastic coat. This elasticity prolongs the impulse given to the blood by the heart.

The veins, like the arteries, have a muscular coat, which, being thinner, is less conspicuous than that of the arteries of man ; it is, however, very obvious in the vena portarum and vena cava of quadrupeds.*

According to Dr VERSCHUIR; the veins contract upon the application of a stimulus.

Comparative anatomy supplies a strong argument in favour of the muscular power being proper to veins. Thus, the bronchial veins of fishes unite, and form the great arterial trunk, called aorta ; and further, the muscular fibres of the veins of the larger quadrupeds, near to the heart, are rendered obvious to the naked eye by dissection.

Dr MONRO also directed his particular attention to the mode of distribution of the arterial system ; and especially to the tortuous course and frequent anastomoses between the internal carotid and vertebral arteries, in diminishing the impetus of the blood sent to the brain, and the effects of the application of ligatures to the carotid arteries.†

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usually found empty after death ; that their contractile power is increased by inflammation, and diminished by palsy ; and, lastly, the predisposing, as well as the more immediate, causes of inflammation lead to the same conclusion.

* Vide Dr MONRO on Fishes, tab. iii.

† The following experiment, which was performed two years ago in the Anatomical Theatre by Mr SPENCE, shews that the different arteries which supply the brain may be obstructed by ligatures, without impairing the functions of the brain. The following is Mr SPENCE's own account of the experiment :

" The first operation was performed on the 16th July 1838, when I placed a ligature, first on the left carotid, and then on the right vertebral artery. My object in adopting this order of tying the vessels, being to direct a larger quantity of blood on their collateral branches, and thus give rise to enlargement of the anastomoses on both sides of

The ramifications of the greater number, but not of all the arteries, anastomose freely with one another. This

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the neck. From many previous experiments on the carotids, I had no fears as regarded the results of the tying both vessels at one time, as I knew that the circulation within the cranium would be carried on nearly as freely as ever by means of the left vertebral and right carotid, as well as by the gradual enlargement of the anastomosing branches of the vessels which were tied. The animal was quite lively, and took food immediately after the operation.

" 2*d Operation.*—Left vertebral tied. The animal seemed dull, and had a peculiar tremulous motion of the head, and unsteady movement during progression (the breathing was not laborious, nor was the pupil perceptibly dilated). The above-mentioned symptoms lasted about twenty minutes. In the afternoon he took food as usual, and seemed quite well. After ligature of this vessel, I conceive the circulation would be carried on nearly as follows :—The left carotid would be filled by means of its free anastomoses with its fellow of the opposite side, whilst the vertebrals would be filled from their communication through the circle of WILLIS and the occipital branches of the carotids, and also from their anastomoses with the recurrent branches of the subclavian intercostals, and from the deep and ascending cervical arteries.

" 3*d Operation.*—Aug. 15. Right carotid tied. The tremulous motion of head took place again as after the previous operation, but in a less degree, and did not last above a few minutes ; the dog took food about ten minutes after the vessel was tied, and seemed quite well. No other symptoms observed.

" On the 2d October (being six weeks twenty-five days from the date of the last operation), the dog was killed, by opening the femoral arteries, and allowing him to bleed to death, and was afterwards prepared by Mr MACKENZIE, and the principal appearances are as follow :—

" The right carotid quite pervious, and distended with injection, till within a short distance on each side of the point where it was tied. The canal of the left seems obliterated for a much greater extent than was actually the case ; for, owing to the injection having partially failed on that side, it became necessary to inject again from above the deligated point, and upon the coats of the vessel drying, it presents the appearance of having been obliterated for a considerable extent. There is a direct communication from the subclavian with the carotid by means of the inosculation between the inferior and superior thyroid arteries. These vessels are much less increased in size than I should have expected from *a priori* reasoning. Indeed, I confess that this was one of the principal anastomoses to which I trusted for directly re-establishing is intended to remove the possibility of an obstruction to the flow of blood in certain parts of the body; and by this

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the circulation in the carotids, and indirectly that of the vertebrals after ligature of these vessels.

"The vertebral arteries are obliterated close to the point where they enter the foramina in the cervical vertebræ. At their lower part, the vessels are filled by means of their anastomoses with the recurrent branches of the subclavian intercostals, which are enormously enlarged. There is a series of arterial loops surrounding the transverse processes, and communicating with the vertebrals and each other. The anastomosing branches of the deep and ascending cervical arteries are also enlarged, and at their upper part the vertebrals communicate with the carotids on each side, by means of two anastomosing branches from the occipital arteries,—the basilar, internal carotids, and circle of WILLIS filled with injection."

The following observations upon the application of ligatures to the carotid arteries and jugular veins occur in Dr KELLIE's very ingenious paper on Congestion of the Brain.[1] "Not only have the carotid arteries and the jugular veins of dogs been secured and obstructed in separate experiments, without stupor and insensibility having been induced, as the ancients had supposed, but both carotids and both jugulars have been tied up in the same animal, without having occasioned the slightest disturbance of the circulation within the head, of which we have an example in the following experiment by the Baron SWIETEN: 'In cane, cui ante octiduum abscideram nervos recurrentes, ligavi utramqui carotidem, nec potui observare illum aliquid mali inde pati: inveni enim hoc animal post alios octo dies elapsos vegetum et alacre; ligavi tunc venas jugulares sine ullo observabili malo. Post quatuor dies inveni canem sanum omnino. Examinans tunc ligaturas carotidibus injectas inveni illas firmissime hærere, et thrombum valde densum et compactum hærere inter ligaturam et cor. Aperto cranio in cerebro nihil mutatum apparebat, imo cerebri volumen potius auctum quam minutum apparebat.'[2]

"As the common jugulars were, I presume, the only veins tied in this experiment, and as the arteries and veins were obstructed at successive periods of eight days, it seemed necessary to have it repeated. The common jugulars, therefore, were tied at the lower part of the neck; and immediately after the recurrent veins and carotid arteries were secured by ligature, from which the nerves were carefully excluded. For two days after this operation, the dog was dull and somewhat heavy, but afterwards recovered his spirits and activity. He was kept alive till

[1] Med. Chirur. Trans. of Edinburgh, vol. i. p. 164. Edin. 1854.

[2] Commentaria in Aphorismos Boerhaavii, tom. i. 173.

conjunction of the branches of the arteries, the blood is probably rendered fitter for its purpose.

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the seventh day, when he was killed by the prussic acid. On dissection, the integuments of the head, and the contents of the cranium, seemed in a perfectly healthy and natural state; the veins of the pia mater were moderately distended, and the sinuses at the basis were well filled; there was no effusion. The veins and arteries which had been tied, continued obstructed."

Very different opinions have been entertained as to the cause of death from hanging: some have imputed it to dislocation of the cervical vertebræ, and others to an effusion of blood within the brain. I have examined the state of the brain and neck of various criminals, who had forfeited their lives to the violated laws of their country, but have never detected a dislocation of the neck, or internal congestion of blood, and therefore presume that death was to be imputed to a stoppage of respiration.

Dr Kellie observes,[3] " On this subject I am indebted to the liberal courtesy of Dr Monro, to whom, as Professor of Anatomy in this University, the bodies of executed criminals are commonly sent for dissection, for some very interesting information, and for an opportunity of myself examining the brain of one who had been hung. 'I may mention a fact,' says the Professor in one of his communications, 'which I omitted formerly, viz. 'that I examined the brain of a person who was hung, and found no internal congestion, but a great deal of blood accumulated in the vessels of the integuments.'

"Shortly after this, I think on Friday the 7th of December last, a female was hung at Montrose, and the body being forwarded to Dr Monro for dissection, he very obligingly favoured me with the following notes of the observations which he had made on her brain: 'The veins of the integuments of the head were much distended with blood, there was a slight effusion of a bloody water between the arachnoid coat and pia mater; and, on removing the membranes, the brain was found to be rather of a paler colour than usual, and felt remarkably soft, so that it gave way at the corpus callosum, upon which some reddish coloured fluid was discharged from the lateral ventricles, but owing to the rupture I could not ascertain its quantity. The brain was much softer internally than externally, so that I could not demonstrate any of the deeper parts to my pupils,—a circumstance which never before occurred to me during the nineteen years I have been Professor. Since I wrote to you I have found a few observations I had made on

[1] Vide Transactions of Medico-Chirurgical Society of Edinburgh, p. 131. Edinburgh, 1824.

Dr MONRO secundus supposed that the length and course of the arteries proper to the different glands have an influence upon the secreted fluids derived from those glands.

Dr MONRO secundus, at a very early period of his life, directed his attention to the state of the coats of aneurisms, of which the following account has been published in vol. iii. of the Literary and Physical Essays of Edinburgh, in a letter from Dr MONRO primus to his son Dr D. MONRO:—"The aneurismal sacs you sent me to Edinburgh were dissected by your brother in my presence. The appearances were the following:—The external loose cellular, and the cellulo-membranous, coats being dissected away carefully, the circular fibrous, commonly called muscular, coat, was evidently seen continued on all the three small sacs in every part of them, but was thicker there than in the sound part of the artery; and, in the most en-

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the brain, and, amongst them, particular mention is made of the softness of the brains of criminals.'

"On the 9th January last two pirates, Heaman and Gautier, were hung at Leith, and Dr MONRO very politely afforded me the opportunity of being present at the examination he was to make of the brain of one of them immediately after execution. On dividing the scalp the blood flowed freely, and in such quantity as to afford ample proof of the congestion of the vessels exterior to the cranium. The dura mater adhered very firmly to the bones, but exhibited no deviation from its usual appearance. All the sinuses contained blood, but in no extraordinary quantity. The larger vessels on the surface, and between the convolutions of the brain, were but moderately filled, and the pia mater was, upon the whole, paler, and less vascular, than we often find it in ordinary cases. About half an ounce of colourless fluid was found at the basis cranii, and there was some appearance of serosity between the membranes. The texture of the brain was rather soft, but the cineritious and medullary portions of its substance exhibited, as to colour and vascularity, nothing characteristic or remarkable. No sooner was the brain removed, than the blood, yet warm, began to rise and flow profusely from the divided sinuses and vessels at the base of the skull. Rather more than a pound escaped in this way, and afterwards coagulated on the floor." *Vide* Transactions of Medico-Chirurgical Society of Edinburgh, vol. i. 1824.

larged part of the sacs, an extraneous substance, resembling a soft steatomatous matter, was intermixed with the muscular fibres. The cellular substance lining the inside of the muscular coat was considerably thicker than natural, and had much the same appearance of an extraneous substance filling its cells. The internal membrane of the artery adhered so firmly to these cells, that it could not be separated, but seemed thicker than in the sound state. Though the circular fibres could not be observed at the sides of the incision made into the fore part of the sac of the left ham, as represented in your figure; yet, as the dissection was continued backwards towards the most distended part, these muscular fibres became less observable, and could not be traced. Whether this apparent defect of them here was owing to a much greater proportion of the extraneous substance above mentioned, or to their having been destroyed by the great distention, is difficult to determine. The internal cellular coat of this sac was considerably thicker than in the smaller ones, but of the same texture. The most internal membrane was in a thickened adherent state. In the part of the great sac of the right ham which came to Edinburgh, no circular fibres could be seen, and the structure was otherwise much the same as that now described of the back part of the sac in the left ham."

It may be proper to add, that my assistant Mr Mackenzie, who has lately paid much attention to the structure of aneurismal arteries, has assured me, that, in such diseased arteries, he has observed the fibrous structure much more distinctly than in those arteries which are in a sound state.*

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* Mr Roux in the comparison he has instituted between English and French Surgery has stated, that aneurisms are more frequent in Britain than in France. I have not sufficient data for determining this point. In the course of my life I have seen a great many cases of diseases of

Of the manner of preventing or stopping Hæmorrhagy by means of Ligature.

" The most simple case is that in which a single vessel, or a cord composed of several vessels, such as the spermatic, running longitudinally, requires to be tied up."

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the heart and aorta, and also several instances of external aneurisms, and, as far as I have remarked, the former are as prevalent amongst women as men. In order to throw light on the prevalence of diseases of the vascular system in this city, I have subjoined the following extract from the journal of the Royal Infirmary, for which I am indebted to my friend Dr J. Reid, to whom the important duty of examining morbid appearances, and of registering them, is entrusted.

Royal Infirmary, *June* 1840.

My Dear Sir,—In answer to your letter I have to inform you, that of the last 400 post-mortem examinations which I have, within a period of little more than two years, made in the Royal Infirmary, in 51 of these, *organic disease* of the *heart*, and *aneurism* of the *aorta* or *arteria innominata*, were the sole or the chief cause of death.

Of these 51, there were 13 died of *aneurism*, and 38 of *organic disease* of the *heart*. Of the 13 who died of *aneurism*, 11 were males and 2 only were females. Of the 38 cases of disease of the heart, 24 were males, and 14 were females. Of the 11 males who died of aneurism the ages of 10 were ascertained,—the youngest was 31 and the oldest 60, and the average age was 42. The youngest of the 2 females was 39, and the older 59. Of the 24 males who died of disease of the heart the youngest was 17, the oldest 65, and the average about 39½. Of the 14 females the youngest was 10, the oldest 60, and the average nearly 35. Of the 24 males who died of organic disease of the heart, the *principal* organic changes upon that organ were as follows :—

Disease of Aortic Semilunar Valves, ...	11
Do. Do. and Mitral, ...	4
Do. of Mitral Valves, ...	5
Hypertrophy of Heart, chiefly of left side, without apparent inadequacy of valves, or narrowing of the orifices of the heart, ...	4
	24

In one of these cases of hypertrophy, there were adhesions of the inner surfaces of the serous part of the pericardium.

" It may be the purpose of the surgeon to use the ligature as a tourniquet during the performance of an opera-

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In the 14 females who died of disease of the heart, the chief organic changes in that organ were as follows :—

Disease of Aortic Semilunar Valves, ...	6
Do. Do. and Mitral, . . .	2
Do. of Mitral Valves, ...	4
Do. Mitral and Tricuspid Valves, . . .	1
Hypertrophy of Heart, without any very apparent cause,	1
	14

In the body of a young woman, aged 19, not included in the above tables, and who died of Bright's disease of the kidneys, the *pulmonary* semilunar valves were exceedingly soft, and broken down into shreds, with irregular soft small masses of lymphy-looking matter attached to them. The inner surface of the artery immediately above the valves had several small flakes of lymph adhering to it, and was of a yellow colour. The action of the heart was tumultuous, and a burst accompanied the first sound for a few days before death.

In the above tables, I have not included cases of recent pericarditis; nor several cases where organic disease of the heart was found after death, but was not the sole nor the chief cause of death.—I have the honour to be your obedient Servant, JOHN REID.

ROYAL INFIRMARY, 1*st August* 1840.

My Dear Sir,—Have the goodness to make the following additions to the account which I gave you of the number, &c., of diseases of the heart and large vessels which I lately sent you.

Of the 4 males in whom the heart was hypertrophied, without disease of valves or arterial orifices, in 2 there was much more of dilatation than hypertrophy, and the walls were pale and soft, and the kidneys were healthy. In the other 2 cases, there was Bright's disease of the kidneys, and in one of them there were also old adhesions between the inner surfaces of the serous membrane of the pericardium. In the female in whom the example of hypertrophy without disease of the valves occurred, there was much dilatation of the arch of the aorta.

With regard to the aneurisms, you will find their position, &c. in the first page of the accompanying pamphlet.

☞ To proceed, then, with this paragraph, so as to include the other cases. In a sixth, the aneurism was upon the ascending portion of the arch of the aorta, and burst into the right auricle and lower part of the descending cava. In a seventh, the aneurism was placed upon the ascending tion, and to slacken it afterwards. In this case he should employ a large ligature, such as will not injure the cord; and he should form a running knot only, that the ligature may be easily removed. But if he intends by this ligature to make a lasting compression of a bloodvessel, and to obliterate its cavity, he should use a small ligature. The surgeon includes in his ligature an artery which has been cut transversely, as in the amputation of a limb."

Of the manner of Employing the Ligature in Checking or Stopping Hæmorrhagy from the mouth of an Artery which has been cut transversely, as in Amputation.

" After having checked or arrested the flow of blood by means of the tourniquet, we proceed to the application of compression on the bleeding vessel, and particularly by a ligature of it.

" Formerly, surgeons were so much afraid of cutting the coats of the artery, by means of the ligature, that they formed it of several flat threads, after waxing them; and

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portion of the arch, and burst into the pulmonary artery. In an eighth, the aneurism was upon the descending portion of the arch, and communicated with the pulmonary artery. In a ninth, the aneurism included the greater part of the arch of the aorta, made its way through the sternum, and burst externally. In a tenth, there was an aneurism upon the descending portion of the arch of the aorta, and another upon the upper part of the arteria innominata. This patient had also tubercles in the lungs. The right recurrent nerve was much compressed by the aneurism on the innominata. He was liable to severe paroxysms of dyspnœa, and had heaviness and inability to cough forcibly. The larynx was healthy. In an eleventh, the aneurism was upon the ascending portion of the arch of the aorta, and burst into the pericardium. In a twelfth, the aneurism was upon the upper part of the ascending portion of the arch of the aorta, and burst into the left bronchus. In the thirteenth, the aneurism was upon the transverse portion of the arch of the aorta, and compressed the left recurrent nerve and the trachea. This patient was subject to violent paroxysms of dyspnœa, and died exhausted by their frequency and severity. The two last cases were females: all the other were males.—Your most obedient Servant, John Reid.

they, in the next place, included, along with the bleeding vessel, a considerable portion of the contiguous parts, for the defence of the coats of the artery."

"But, in this way, contiguous nerves or vessels were often wounded by the needle, or injured by being included within, and bruised by, the ligature; and, besides this, the ligature often became loose in consequence of the wasting of the cellular, adipose, or muscular soft parts, before the cavity of the principal artery was obliterated, in consequence of which a hæmorrhagy ensued."

"Instead of this method, late experience has fully proved it to be more expedient to lay hold of the bleeding vessel with forceps, a common hook, or a needle flattened near its point, and called by surgeons a *Tenaculum;* and, after drawing it out singly, to tie a thread around it; and, instead of taking a broad and flat ligature, or putting *toile** linen, or flat pieces of wood or metal, between the artery and the ligature, to use one that is round and small; and instead of drawing the knot on the artery very gently and with great caution, Dr Jones has proved, that the knot or thread should be drawn so tight as to occasion a rupture of the soft and brittle innermost and muscular coats of the artery,† which the great toughness of the external coat allows to be done without danger of hæmorrhagy from its being cut by the thread."

Mr Veitch has gone a step farther, and has proved, by repeated experience, that a single silk thread does not cut the external coat of the artery, and therefore may be used with safety, and answers the purpose better than a larger ligature, which proves, by its irritation, a bar to the healing of the wound.

Formerly, it was not unusual to cross the thread twice before it was drawn, with the view of preventing the knot from yielding to the impulse of the blood, and *this kind of knot was termed the surgeon's knot.*"

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* Scarpa.

† Mr Crampton's observations (*Vide* Medical Chirurgical Transactions, vol. vii.) have proved that the obliteration of an artery takes place, though the coats of the artery have not been divided.

"But when the thread is passed twice before the knot is drawn tight, it does not grasp a small vessel sufficiently; hence, now-a-days, most surgeons, instead of it, cross the thread once only before they form a knot, and then form a second knot over the first, in order to prevent that from opening or yielding to the force of the blood.

"I have, however, for many years past, ventured to allege, that one highly important improvement remains to be made in the practice of surgeons on this point; *I mean that, the surgeon ought never to form two knots*, because it will often happen that the soft parts on the outside of the artery, which are often included with it in the ligature, will be cut or wasted before the artery is contracted and impervious; and hence the hæmorrhagy may return, as the surgeon cannot tighten the ligature by pulling the ends of the thread, and may find it very difficult to lay hold of the artery, so as form a new ligature. I have, therefore, long earnestly recommended to students to form *one single knot only*, as there is not the smallest danger that this will be opened by the impulse of the blood; and the surgeon, if it should open, can tighten it again at his pleasure. I was led to propose this not only from the reason of the thing, but from having observed how much a single knot resists the force of anatomical injections in dead bodies; and, in fact, I have found by the following experiments *that the single knot, with a small thread, is sufficient to restrain completely the flow of the blood from the trunks of the humeral and femoral arteries divided transversely*."

About thirty years ago, I laid bare the upper part of the humeral artery in two pigs, and tied it up in two places, very near to each other, with a single knot, and then cut the artery across between the ligatures, without any hæmorrhagy ensuing, or any loss of motion in the limb.

"I kept both pigs alive until the wounds healed, and for about three weeks thereafter, with the view of observing the effects upon the lateral branches of the artery, which I found, after injecting them, to be dilated."

" Lately, on February 20. 1808, *I repeated this experiment on both humeral and anterior femoral arteries of two swine near to three years old, each of them weighing upwards of one hundred pounds avoirdupois, in the following manner.*"

" *I laid in view, by an incision of the teguments, the upper parts of the left humeral and left anterior femoral artery in both swine. I then passed a small crooked needle, followed by a single silk thread, behind all these arteries, with which I formed a single noose or knot, which I tightened so much as to stop the flow of the blood.*

" *Eight days thereafter, two such ligatures, very near to each other, were passed around all the same arteries, on the right side of both swine, and the trunks of all these were cut transversely between the ligatures.*"

" *The threads were laid out at the ends of the wounds, and the sides of the wounds were kept contiguous to each other by adhesive plasters.*"

" *There was no hæmorrhagy in any of these experiments, the wounds healed soon in the most kindly manner, and without any loss of power in the limbs.*"[*]

" Six months after the above experiments were performed, I killed both swine, injected and dissected their arteries with care. Their lateral branches, were much less dilated than I expected, owing, I believe, in a great measure, to a circumstance I did not till then know, that the anastomoses of the principal branches of the arteries of their limbs are much larger than in man, in consequence of which their blood passes with less resistance from any one artery into another."*

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[*] Sir A. Cooper has made an observation which merits peculiar notice. He observes, " the femoral artery had been tied by two ligatures as firmly as could be done without the risk of cutting it through." He adds, " while proceeding to dress the wound, I saw a stream of blood issuing from the artery, and when the blood was sponged away, one of the ligatures was found detached from the vessel. Soon after, the other was also forced off, and unless immediate assistance had been afforded, the patient must have perished from hæmorrhage."

"If the mouth of the cut and bleeding vessel cannot be seen, or that, from its being tender, it cannot be drawn out by the forceps or tenaculum, so that a thread can be tied around it, it will be necessary to surround the vessel by a crooked needle conducting a thread, and to include some portion of the parts that are contiguous to the bleeding vessel, and then to draw the thread tight upon them."

"For this purpose, the needles should be smaller and smoother on their sides and edges; and more exactly semicircular than those commonly used; with a deep groove between the eye and the end of the needle for lodging the thread, that it may follow the needle easily; and with the same view, and also that the ligature may occasion the rupture of the internal coats of the artery, the thread should be much smaller than is commonly used."

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* Dr MONRO secundus made a great many experiments with ligatures on the different arteries of living animals, which led him to observe, I quote the words employed in one of his lectures, "where, by the death of the patient some time after a large artery had been tied up, there has been an opportunity of examining the lateral anastomosing branches, and comparing them with those of the sound limb, they have been found to be very sensibly dilated. One remarkable case of this kind, in which the lower part of the humeral artery had been tied up, has been described by Mr WHITE of Manchester. (Cases of Surgery, 1770.) I made, many years ago, a few experiments on animals, with the view of shewing how much the lateral branches were dilated, but have not prosecuted them sufficiently. Upon the whole, it has appeared that the large *trunks of the arteries in the external parts of the head, neck, and in the whole extent of our extremities, may in general, and particularly in young and healthy persons, be tied up without preventing the blood from circulating in such quantity* as to nourish the limb or part in which the experiment has been made." The same observation may, according to the experience of Mr HODGSON, Sir A. COOPER, and other surgeons, have been extended to the arteries of old persons, beyond the age of sixty. Sir ASTLEY cured a patient aged eighty-five, who was afflicted by a popliteal aneurism.

My Father has contributed considerably to the improved method of treating aneurisms, of which, at my particular request, he drew up the following statement. "When a student, I made an experiment along with Mr EMMET, afterwards State Physician in Ireland, of tying up and cutting both *carotides communes* of a dog, which was mentioned then to the students of anatomy, and of which an account was afterwards published by Dr EMMET in Ireland, on the supposition, that such an operation might be useful to persons labouring under epilepsy and other disorders.

"In the year 1759, when I began to deliver the whole course of lectures on anatomy in this University, I shewed to the students, and continued to do so annually, that the humeral artery did not divide into its radial and ulnar branches till it had got about an inch below the joint of the elbow; and therefore that the wound commonly made in the artery on blood-letting at the elbow, was made in the trunk of the humeral, and not in the radial artery, as Dr WILLIAM HUNTER had supposed."

"To shew in fact that the humeral artery might be tied up without occasioning mortification, my Father mentioned that, in several cases of bastard aneurism, he had performed this operation with success; and, later than this period, he stated in his course of lectures that he had witnessed four such successful cases." "To prove this still more evidently, I tied up in a pig the trunk of the humeral artery, upwards of an inch above the elbow, and, about a month thereafter, killed the pig, injected its arteries, and had a drawing and engraving of it made by the late Mr THOMAS DONALDSON, which I preserve, along with the preparation, in which the anastomosing vessels, somewhat enlarged, are distinctly seen."

"Soon after this, in the year 1760, I received from my brother Dr DONALD MONRO, physician in London, the account of a case of true axillary aneurism, which I read then to the Philosophical Society of Edinburgh ; and in order to render the description of it more intelligible to them, I directed a painter to take a sketch of the axillary vessels from a table of them published by Dr HALLER, and upon this to engrave a figure of the aneurism, which was published by the Society in the next volume of their Transactions in 1770."

"In this case, my brother found a hole in the axillary artery leading into the aneurismal sac ; and below this place, *the side of the bottom of the axillary artery or top of the humeral artery, had coalesced*, owing, I suppose, to the pressure made on the artery by the aneurismal sac. Upon the above case, I used in my lectures to make two observations, to-wit, that, in the first place, the arm, as well as the life of this person, might have been saved by a ligature of the subclavian or axillary artery, and, in the next place, that such an operation might be practised in the case of an aneurism or wound of any artery of the superior extremities."

"After this, in the year 1787, I sent to our Infirmary, a boy twelve years of age, who had been wounded in the middle of his anterior femoral artery with a penknife, who was recommended to my care by Mr WETHERSTONE, surgeon in Lauder. He was cured by tying up the trunk of that artery ; and, very lately, I had the satisfaction of seeing him in his house, stout in his limbs, and without a halt in his walk, or other sign of lameness."

"Still later, in the year 1797, a man about fifty years of age, with an aneurism of the size of an English pint bottle, in his left groin, was recommended to my care by Mr PATERSON, an eminent surgeon in Berwick. I put this patient into the hands of Dr WARDROP, one of the best surgeons and operators in this city, who agreed with me, that an operation ought to be performed without delay ; but unfortunately Dr WARDROP was dissuaded from executing his purpose by other surgeons, who did not suppose that the operation would be attended with success, and the patient died soon thereafter by the bursting of the sac. I procured, and still preserve the aneurismal sac, which began at the top of the anterior femoral artery, immediately below where the external iliac, after sending off the epigastric artery, divides into its anterior and profunda branches. The following is an extract from a manuscript copy of my lectures, which was taken in short-hand in the year 1770, by Mr Thorburn."

"We are led from these facts to make the application to other cases, and particularly, I may allege that there is much probability *we should be able to save the arm or the leg by making ligatures upon their arteries near to their very beginnings;* for water squirted into them, passes freely by their lateral communications to their lower parts. But the chance is somewhat less in the legs, as a greater size of member must be nourished by similar but smaller vessels. In one case, which you will find in the Physical and Literary Essays, the sides of the humeral artery were found grown together, by the compression of an aneurismal sac, the lateral branches probably dilating as the aneurismal tumour formed and increased."

Since my Father's death, cases have been published by Dr Goodison, and by myself, in which the blood continued to flow to the inferior extremities, though the abdominal aorta had been obstructed by coagulable lymph. Nature had in these cases produced the same effect as the ligature which Sir A. Cooper had thrown around the abdominal aorta, who has pointed out the accuracy of those principles, and the propriety of his attempt to save the life of a patient weltering in his blood, and in the most imminent risk of immediate dissolution.

Combining together the results of the experiments of Sir A. Cooper upon dogs (which, it may be remarked, have been attended with similar results in the hands of others), and the cases which have fallen under the notice of Dr Goodison and of myself, there can be no doubt as to the safety and expediency, in certain cases, of throwing a ligature around the abdominal aorta.

The following observations upon the distribution of the bloodvessels of the inferior extremities, have been taken from a manuscript of my Father's lectures, and they tend to prove that he had essentially contributed to the improved knowledge of the mode of ramification and anastomoses between the ramifications of the arteries of the pelvis and inferior extremities, and consequently to the more modern improvements in the surgical treatment of aneurisms.

" The abdominal aorta is so closely applied to the spine, or so firmly supported behind, that the whole dilatation and motion of it is forwards, and hence in very lean and exhausted people, I have several times been able to distinguish the pulse or the stroke of it distinctly, and this has led surgeons in some of these cases to apprehend a beginning aneurism ; if you lay very thin and exhausted persons on their backs in bed, raising their shoulders, the abdomen yielding a little inwards, you may distinctly feel the stroke of the aorta. And this observation may be applied to real use, as, supposing that a large artery of the pelvis or top of the extremity is accidentally or necessarily wounded, *I apprehend that in such persons it is practicable, by a cushion and belt applied, to moderate, if not altogether to restrain, the current of blood, and lessen the force with which it is thrown out.*

" Tracing the aorta, we find it dividing into two iliac branches which are perfectly equal, so that no reason appears from the division of the vessels, why the one leg should be preferred to the other, and hence perhaps we very readily learn to give the preference to the left leg, when an accident happens to the right arm. We observe, indeed, that the right leg is somewhat stronger than the left, but that is perhaps from habit.

" These iliac arteries sweep around the brim of the pelvis; if they had run over the cavity of the pelvis, the weight of the bowels would have been in danger of tearing them ; whereas the turn at the side gives them the support of the muscles, particularly the psoas, at the inner side of which they are placed.

" From the size of the angle, the blood descending rushes with violence against the angle, and perhaps on this account that part of the aorta, next to the origin of it at the heart, is the most subject to diseases : There are frequent examples of ossifications about this place.

" As the vessels divide equally and into two branches only, the anterior and posterior iliac arteries, an opportunity is given of comparing the size of the branches with that of the trunk, the proportion laid down by HALLER and others is nearly just ; that is, that where an artery divides into equal parts, these, compared with the trunks, are in the proportion of three to two.

" The uterine branch chiefly supplies the body of the uterus : it does so more than the spermatic artery, which runs down first on the ovarium, and only reaches the uterus afterwards ; whereas this is implanted immediately in the uterus, and from the extremities of this chiefly proceeds the menstrual flux. Hence a proposal has been started, in order to promote the menstrual flux, of making a pressure upon the external iliac, or upon the femoral artery, in order to increase the momentum in the internal. Now, though I would not expect as much from this as the gentleman, Dr HUNTER of York, who has proposed it, in the second volume of our Physical Essays, because I do not find that a mere increase of the force of the blood immediately brings on that flux, yet the proposal is rational, and we may at least assist by such a pressure ; and some cases may be more particularly adapted to the experiment than others. I have in come cases proposed that it should be done ; but I cannot give a satisfying account of the success; so many trials are necessary, and so many circumstances vary the effect of every trial; and perhaps, in many cases, the directions might not have been very properly followed. But as the experiment is simple, and can have no bad effects, it is worth pursuing.

"Next, we observe an artery common to both sexes, the arteria pudenda communis, which, in its passage to the organs of generation,* supplies the extremity of the rectum, the common seat of hæmorrhoidal tumours; and the corresponding veins return the blood into the internal iliac, or cava. So you will find a necessity for discovering some other cause for piles, than that generally assigned.

"The situation of these vessels in both sexes, is not only similar but singular, the principal artery lies between the levator ani, and the os ischium, with an accompanying vein; but the vein is small in proportion to the artery, and contrary to the common rule, the arteries are more superficial than the veins. So some particular purpose is intended, and we are enabled to account for the distention of the corpora cavernosa both of the penis, the clitoris, and the cavernous substance at the mouth of the vagina.

"Branches of the internal iliac enter the holes of the os sacrum, and these are dispersed on the lower part of it; and hence, in making experiments, the ligature on the descending aorta, or on the iliac arteries, has a remarkable effect in bringing on paralysis.

"A branch runs down through the foramen thyroideum, and other branches are sent out backwards, particularly one with the sciatic nerve.

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* Dr P. CAMPER, in his folio plates representing the surgical anatomy of the pelvis, has depicted, with his usual fidelity and spirit, the more common distribution of the arteries of the pelvis. I have also depicted the common, and also the more uncommon varieties in the course of the arteries proper to the organs of generation. TEIDEMANN's plates of the arteries of the pelvis also well merit the examination of the reader.

"We are now, then, able to judge better than formerly of the places where hernia will most likely happen. Where-ever a cord of vessels or nerves runs out, the connection must be loose to allow the vessels or nerve to accommodate its situation to the flexion or extension of the body. Hence, the herniæ most commonly happening are the umbilical; that through the ring of the external oblique, called inguinal, or rather scrotal in the male; and that where the herniary sac follows the femoral vessels, called crural. I would add now two more places, viz. the foramen thyroideum, and the notch of the os ilium behind. Of the former kind, we have about twelve examples; of the latter, very few, partly on account of the tendinous membrane about the sides of the hole, which supports the bowels, and partly on account of the thickness of the glutæi muscles, which conceals the hernia when it happens.*

"Next, we remark, that these last-named branches of the iliac artery descend a considerable way upon the extremity. The branches of the obturator† artery anastomose with those of the internal circumflex, and the ischiatic descending on the outer side, where the branches of the external circumflex are evidently recurrent.‡ In most subjects, we cannot very clearly, by dissection, shew their communications; the communications are small, *but in all subjects I am convinced that the communications are numerous, as we can make an injection pass from the external iliac into the inter-*

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[*] The reader is referred to the admirable works of CAMPER, Sir A. COOPER, LAWRENCE, SCARPA, WARDROPE, LISTON, CLOQUET, LANGENBECK, and Quarterly Journal of Foreign Med. vol. i., for descriptions and representations of different herniæ.

[†] I have endeavoured to describe, in my Morbid Anatomy of the Gullet, Stomach, and Intestines, the varieties as to the origin of the course of the epigastric and obturator arteries, in relation to inguinal and crural herniæ.

[‡] There is also an anastomosis between the glutæal artery and a branch of the artery called profunda.

nal through these. It is *material to observe this, because it shews the possibility, and even the probability, of saving the limb, as well as the life, of a person, where a wound has been made very near to the trunk of the body.* Or we are now led to apply what I proved with respect to the arm, that *the principal artery of it may be stopped or tied as high as its origin, and still a sufficient quantity of blood be furnished to nourish the member.* Within these few years, we find practical proofs of this; experiments have also been made on the middle of the thigh."

"When speaking of aneurisms in general, we found that these are most common in the great vessels near to the heart; but these are not peculiar to the large vessels only. I have seen several cases where small arteries were the subject of them, and, in one case, I have seen an aneurism formed where the sciatic nerve runs down, which occupied as much of the teguments as one can cover easily with the hand. The bulk was formed before the patient was aware of any uneasiness; nor was he sensible of any increase for a considerable length of time. After considering the case, it was determined not to hazard an operation, because of the uncertainty of the beginning of the tumour. We endeavoured to search *for that by feeling the fore part of* the pelvis, *and by introducing the finger into the rectum*, but no unusual pulsation was perceptible; but it might have come out from the pelvis in the conical shape: besides, there would have been the utmost difficulty, in the time of the operation, in making a compression. So it was in this case that I thought *of compressing the aorta, and of examining the pulsation of it in different ways.* Another difficulty arose from the vicinity of the artery to the sciatic nerve, that the coats of the nerve might have contracted an adhesion to it. So I gave directions, with a view to prevent the rapid increase of it by moderating the circulation of the blood, that the patient should avoid exercise, and all violent efforts; I expected that, in a few months, the tumour would enlarge so much as to burst. But it still remains nearly of the same size as at first. I was of opinion that, if the teguments had become affected, then the bursting of them should not be hazarded, but that then the operation was to be had recourse to. From this case, it is evident that aneurisms form without an evident cause in small arteries, and that there is necessity of caution in making the prognosis, and that the disease sometimes continues longer without change than we could expect. I have, in like manner, attended a case where the whole sternum was split by an aneurism,* and the bone annihilated, and in that case the increase was extremely slow. Still later, I have met with a case which surprised me more than these, a tumour formed in the neck, which, from the very first appearance, was said to have had every mark of aneurism, and when I saw it, was of the size of the egg of a turkey; and since that *time it has gradually shrunk, and the patient is well.* We may be mistaken, perhaps, if it were so in that case, by other tumours forming near to an artery, and receiving the stroke of it; but generally these undergo some farther change, after the tumour has acquired a certain size; generally it suppurates, if it is of an inflammatory or scrofulous kind."

The external iliac runs a great way without any remarkable branches; hence it is a very good subject for experiments upon arteries. Soon after, and before it gets behind the tendon of the external oblique, it sends off the epigastric and circumflex arteries. The situation of the epigastric I remarked, on account of the danger of cutting it in performing the operation for the femoral hernia.*

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* Previous to the protrusion of an aneurism of the arch of the aorta through an aneuric aperture in the breast-bone, the size of which is various, the patient generally suffers the most excruciating pain in the region of the breast-bone. I have seen the aneurism burst in the course of a few weeks, and from the patient making so slight an effort as the turning in bed; but in other cases the protruding aneurism is filled up by layers of coagulable lymph, and becomes at length a solid tumour, which, by compressing the lungs, and impeding the free circulation of blood through them, proves the cause of water in the chest.

"The artery subsequently comes out into the thigh, covered with the aponeurosis over the muscles, and soon after the inguinal glands are laid over it. The situation of these is carefully to be attended to, especially when you have seen that the artery rises nearer to the surface than the vein, contrary to the common rule. In venereal cases *where buboes form, there is surely no necessity nor argument for having recourse to an operation*, which has been practised, of extirpating the bubo by an incision, except when the bubo originates from cancer, whereby we at least lessen, if we do not altogether prevent, the contamination of the blood."

"In such a case, the artery will closely adhere to some of these glands, not only in consequence of the increase of size, but of the inflammation which attends it."

"Caustic is frequently employed for opening venereal buboes; but, from the number of cases which I have seen where they did well, where matter was merely discharged by the bursting of the tumour, if the opening be near to the under part, I am doubtful whether larger openings be at all necessary. But supposing that they are, we may, if the tumour be large, apply a caustic, provided it be confined to the surface of the gland; for if we do not confine it within the edges of the gland, and that it shall spread further, and eat in at the side of the gland, it may corrode large vessels, and at least weaken their coats. Still more should caustic be avoided, where already sinuses have formed, because, from getting into these, it may go to a considerable depth. In short, the lancet and the knife are to be preferred to caustic.

"I was particular in pointing out the situations of the vessels, and of the nerves with respect to the joint. I shewed that, though the bloodvessels pass over the head of the os femoris and the immediate cavity of the acetabulum, yet there is a possibility of reaching the neck of the bone farther out. Or, I meant to shew the possibility of making incisions into this joint, which may, in some cases, be done with propriety. So, in one case, I found a quantity of dark green coloured matter within the ligament on the fore part, and, examining the pelvis, I observed that the matter was diffused within it, the bones being eroded and deprived of their membranes. Therefore, though I am far from considering the opening into joints as a matter of little consequence, considering the sensibility of ligaments, yet it is better to give the matter a discharge than to trust to the erosion of the ligament, which, from the air getting in, would have the same bad effect as in the cutting, besides, that the matter may corrode the bone and get within the pelvis. As the capsular ligament does not merely include the round ball, but descends to the bottom of the neck of the os femoris, an incision can be made with the utmost safety, and in the place we would choose, at the lowest part of the joint, without the tendon of the internal iliac muscle, and within the head of the sartorius, and at a sufficient distance from the nerve as well as from the artery, and in that part of the ligament which includes the cervix of the thigh-bone."

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* It may be added, inguinal herniæ. In my book on different Herniæ, I have pointed out the relative situation of the epigastric and obturator arteries in respect to inguinal and crural herniæ.

"We now follow the artery over the vein, and find it giving off the profunda femoris, which perforates the muscles, then descends near to the joint of the knee, and repeatedly communicates with the trunk of the femoral artery. Following the trunk farther, it passes through the long head of the triceps muscle, which passage is carefully to be observed by surgeons, because, when amputation is performed in this part of the thigh, the artery may, by shrinking within the muscle, make it difficult for the surgeon to lay hold of it. But if, in this case, of which my Father used to mention an instance, we cut the muscle away from the bone, the mouth of the artery is readily discovered."

"There are several particular branches sent round the joint in a circular manner, resembling the branches above the elbow; and from the number of communications more especially formed about the middle of the thigh,* I have alleged, that every conclusion with regard to the superior, may be applied to the inferior, extremity. Of late years, we have three or four cases, where the femoral artery was tied up, and the limb saved, contrary to the common rule of having recourse to amputation, providing the wound was certainly in the trunk. *So, instead of amputating in such a case, let us attempt to save the limb* by using a *ligature. I cannot say with certainty, that we shall always succeed in a recent case, where no pressure on the trunk has been made for a length of time, as well as in the case of an aneurism.* I have made that experiment upon frogs: some survived the operation, but the limb of others mortified. Hence, we should only proceed to amputation, when the mortification shewed that to be the only resource.

"After the femoral artery has perforated the adductor maximus, and got into the ham, it sends off a number of small branches, called circumflex, which anastomose with the branches of the profunda, and with the branches sent off from the anterior femoral both above and below the knee; so that there can be little doubt that the popliteal artery can be tied up without occasioning mortification of the leg."†

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* The anastomoses of the bloodvessels of the extremities have been very faithfully represented by SCARPA, in his Treatise on Aneurism.

Various valuable observations on the anastomoses of the arteries have been published by Professor HARRISON, of Dublin, in his Description of the Arteries, and by the late Mr ALLAN BURNS, of Glasgow.

† From a careful perusal of the preceding Lectures, it is obvious, that my Father had suggested the possibility of moderating the flow of blood through the abdominal aorta, he having actually recommended this to be put into practice in a case of a large aneurism of the glutæal artery. That such means of arresting the flow of blood through the abdominal aorta and its branches is not only practicable, but highly expedient, has been proved by the observations of Dr EHRENREICH in stopping the flow of blood from the vessels of the womb, when it is profuse. "I therefore

Lastly, upon consulting the records of physic and surgery, it will be found that our knowledge of the nature and treatment of aneurism has arrived gradually at its present state of perfection, in consequence of the inves-

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determined," says Dr Ehrenreich, "to lay a heavy sand-bag, as recommended by Kluge and Belscher, on the part of the abdomen corresponding to the uterus. *The moment the bag was well placed, all bleeding ceased.* In two hours after, the skin had recovered its warmth, and every bad symptom disappeared."[1] He has given a full description of the case of a woman who had lost a great deal of blood after labour. He endeavoured to stop the flow of blood, by introducing his hand into the womb, so as to make pressure upon the vessels pouring out the blood; but his fingers became so cramped, that he could no longer maintain the pressure.

The case in question is very strong in point, and merits peculiar notice; and the more especially as Mr Hodgson, a very experienced surgeon, who has written by far the best treatise on aneurism, and in which he has displayed great research, has observed, p. 424:—"The danger which attends the exposure of the cavity of an aneurism, in a situation in which it is impossible to command the flow of blood by the compression of the artery above the tumour, has deterred surgeons from repeating Mr Bell's operation."

In the same lecture, the communication between the branches of the anterior and posterior iliac arteries is also mentioned; so that the blood will still find its way to the knee and foot, though a ligature be thrown upon the anterior iliac artery, an operation now-a-days frequently performed with success. The late distinguished Mr Abernethy, I believe, was the first surgeon who performed the operation for iliac aneurism, in the year 1796. His first operation was undertaken to avert inevitable death. *His two first cases proved unsuccessful, but not from the want of supply of blood, as has been fully proved by subsequent experience.*

Sir A. Cooper shewed me a preparation, in which a ligature had been applied to the external iliac artery.

I have subjoined the history of the anastomosis of bloodvessels in Sir A. Cooper's second case. The patient survived the operation nearly three years. The following was the distribution of the arteries:—The external iliac and femoral arteries were obliterated, excepting about an inch of the femoral artery, just below Poupart's ligament, which still remained open, and continued to convey a portion of the blood; but below this part, it had become simply a ligamentous cord. The internal iliac artery sent first a very large artery of communication to the epi-

[1] *Vide* Page 275 of Dr Forbes's British and Foreign Medical Review for July 1840.

tigations, experiments, and operations, that have taken place chiefly in this country; and, it may be added, that the cases of obstructed aorta render complete the history of aneurism.

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gastric and obturator artery, so that the epigastric was supplied with blood from the internal iliac. Secondly, the internal iliac sent an artery of communication upon the sciatic nerve to the internal circumflex artery: the glutæal artery gave a large branch to the origin of the profunda. Lastly, the internal pudendal artery largely anastomosed with the obturatrix: the obturatrix, therefore, in this case, sprang from two new sources, viz. from the internal iliac, and from the internal pudendal artery, and the obturatrix thus formed sent two branches of communication to the internal circumflex artery. The arteria profunda was, in this case, supplied from two sources,—directly from the glutæal, and more indirectly from the internal circumflex, by the obturatrix and ischiatic arteries.[1]

In this case, a portion of the femoral artery, between the part obliterated by the ligature and that in which the aneurism existed, retained its calibre. The blood entered this portion of the femoral artery through the epigastric and circumflex iliac arteries, and passed out of it through the profunda. The blood which entered the ascending branches of the profunda from the glutæal, ischiatic, and obturatrix arteries, instead of being discharged into the femoral artery through the mouth of the profunda, passed down the perforating branches of the latter into the articular arteries of the knee.

In the same lecture, the communication between the ramifications of the profunda femoris artery and of the articular of the knee, is mentioned, which led Mr Hunter, in 1785, to perform his operation for the popliteal aneurism, by passing a ligature upon the femoral artery, on the anterior and inner part of the thigh, somewhat below its middle; one of the greatest improvements in modern surgery, and which is based upon the strictest anatomical, physiological, and pathological principles; to which is superadded the greater facility of performing the operation, and the removal of the risk of secondary bleeding and formation of sinuses. Lastly, the danger of ulceration extending from diseased inguinal lymphatic glands to the adjacent femoral artery, is pointed out most clearly, and also the risk of applying caustic largely to buboes, and of the excision of diseased inguinal glands.

[1] Medico-Chirurgical Transactions, vol. iv. p. 425, plate v.

ESSAY V.

OF THE CAUSE OF THE DANGEROUS INFLAMMATION WHICH GENERALLY FOLLOWS THE WOUND OF A SHUT SAC, AND OF THE MANNER OF PREVENTING IT.

This subject, during a number of years, engaged the attention of my Father, and was a favourite one with him; and he has published his sentiments on it, in sect. ix. of his Book on the Bursæ Mucosæ.

Considering the immediate reference of this subject to the practice of surgery, it must be admitted to be of peculiar importance and interest. It suggests an improved method of treating wounds, and of performing several of the operations of surgery.

I am fully aware that the opinions of my Father on the subjects of this Essay have not been generally adopted; on the contrary, they have been much objected to and criticised: but as they are based upon induction from facts, upon many experiments performed upon living animals and pathological observations, and the results of surgical operations; and as they have very lately received sanction from M. Guerin's observations and experiments, I trust that the English reader may not be disposed to impute blame to me for again directing his attention to the observations of my Father and M. Guerin on the effects of the contact of the air on wounds.

In the preceding pages, this subject has been alluded to, but not fully discussed, in treating of the puncture of the chest, and the treatment of strangulated herniæ. I shall, therefore, now direct the attention of the reader to my Father's observations on the subject in general; and in the next place, to the method he has proposed for the removal of cartilaginous bodies from the joints, which are the products of disease; for performing the operation of the trepan; for the treatment of penetrating wounds of the abdomen; lithotomy; and for wounds of the joints and bursæ mucosæ.

" From considering the much greater degree of inflammation, pain, and danger, which attend compound than simple fracture and luxation, and the several facts above stated, with the danger which attends wounds penetrating into the cavities of the head, chest, or belly, it has always appeared to me, that the bad symptoms were much more owing to the admission of the air than to the mere division of the solid or membranous parts. And in this opinion I was much confirmed by the great number of experiments I made on living animals at different times, and particularly in the year 1771; in which, with various views, I laid open the cavities of the thorax and abdomen: For in these I found that the danger was not proportioned to the size of the wound inflicted, but to the time and manner in which the bowels were exposed to the air. I have therefore always calculated in my lectures, but more especially since that period, the advantages which would attend the exclusion of the air from the deep recesses of the body in performing different operations, and in treating wounds accidentally inflicted.

" In the case, therefore, of cutting into the knee-joint for the purpose of extracting such cartilaginous bodies as have been described, I have always proposed an advice, which I would anxiously recommend, by having heard of, and witnessed more than, one instance of bad effects when it was not attended to; I mean the drawing up the skin as much as possible before the incision is made, and, as soon as the cartilaginous body is extracted, covering the wound in the ligament, by letting the skin fall down to its natural place, and securing it by proper dressings; at the same time keeping the joint at rest, and pursuing the antiphlogistic course.

" In the operation of the trepan, I have advised that the cranium should not be entirely cut with the saw, but that the operator should desist from sawing when the innermost lamella becomes so thin that it can be easily broken off with a levator or forceps; by which we not only avoid the danger of the instrument pressing rudely on the brain, but also, in many cases, the cutting of the dura mater, and admission of the air to the surface of the brain; which, in experiments I made on half a dozen pigs near thirty years ago, I found increased the danger considerably.

" The abdominal viscera, I have already observed, are dangerously affected by the air of the atmosphere admitted through wounds. But I have met with three cases, in which the air escaped from the alimentary canal into the cavity of the peritoneum, and occasioned a true tympany, attended with such a degree of inflammation, as occasioned, in a few days, slight adhesion of the different parts of the intestines to each other and to the peritoneum, and no doubt contributed much, with other complaints, to the death of the patients.

" There likewise seems to me to be strong reason for supposing that the danger, not only in the high but in the lateral operation of lithotomy, may be lessened by the surgeon using every means to exclude the air from the wound and bladder during these operations, and by stitching the teguments after the high operation.

" The late celebrated Mr Smith, surgeon in Perth, lost, as appears by a copy of his manuscript in my possession, eight out of eighteen patients on whom he performed the high operation: and I have observed, that those patients generally died, or were in great danger, where the presence of a number of small stones rendered the operation tedious, from the necessity of introducing the forceps repeatedly.

" We may not only observe violent pain produced in the joints, by swelling, gout, and rheumatism, but where wounds have accidentally penetrated into the cavities of the joints, or have been made with the intention of evacuating water, or of extracting cartilaginous bodies, if the wound has not been properly closed, and the joint restrained from motion, a very considerable and painful swelling of the whole joint has ensued; which in some cases has terminated fatally, or, to save life, there has been a necessity of having recourse to the amputation of the limb."

I am fully aware of the various objections which have been proposed to these observations of my Father regarding the pernicious effects of the air upon the deeper parts of the body.

It seems unnecessary to reply to these, as that has already been done in the most complete manner by high authority; by Messrs BENJAMIN BELL, LISTON, and M. GUERIN.

M. GUERIN has proved, by the most incontrovertible evidence, that, as long as wounds are excluded from the contact of the air, there is seldom a tendency to inflammation; and the healing of the wound is rapid.

He has proved, by observations made on the human body, and by experiments on animals, that the subcutaneous incision of joints is as exempt from danger as that of tendons, muscles, nerves, and small bloodvessels; and, moreover, that it may afford, *in certain cases, a valuable means of cure in the hands of the scientific surgeon.*

In two dogs, he opened successively, by the subcutaneous method, the humero-cubital, the radio-carpal, the femero-tibial, and the tibio-tarsal joints; and he found that, *whenever the wounds were kept quite excluded from the admission of the air, they rapidly healed, without any inflammation.*

When the joints thus opened *were allowed to be moved about, a synovial swelling usually appeared around the wound;* but when they were kept quite quiet and extended, even this trifling accident did not supervene. If, however, the air was permitted entrance, inflammation and subsequent suppuration were invariably induced.

M. GUERIN, reasoning upon the results of these experiments, as well as upon what is well known to happen after some severe dislocations, very rightly inferred that there cannot *be any essential danger in making an incision into a joint, provided the air be excluded from the synovial cavity.* He has now, in several cases, divided the ligaments and a portion of the capsules of the knee and ankle-joints; and in none of these operations has any unpleasant symptom manifested itself.

The wound in the integuments should always be as small as possible, and far distant from that into the joint.* Moreover, it should be made when the limb is extended, but never when it is bent; and lastly, the joint should be kept perfectly motionless for some days afterwards.†

Mr B. BELL‡ observes, when treating of wounds in general, "The danger will be increased by the chance of some organ of importance being directly injured *by air*," &c.

Mr LISTON has observed,§ "Great risk attends interference with bursæ near joints, or cysts containing serous or glairy fluids in any situation. Even trifling puncture into such have sometimes been followed by inflammation of the inner secreting surface, and violent constitutional disturbance."

The same author, in describing the treatment of *ganglia*, has observed: "I have removed several large ones by incision; but the whole cyst can seldom be taken away, and there is great risk of inflammation ensuing, followed by sloughing of the tendons, and by rigidity of the part."

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* This mode of operating, proposed by M. GUERIN, corresponds with that proposed by Dr MONRO secundus.

† *Vide* Dr JOHNSON's Med.-Chirur. Review for October 1840, p. 519.

‡ *Vide* Syst. of Surgery, 6th edit. vol. i.

§ *Vide* Elements of Surgery, 2d edit. p. 92. London, 1840.

"From my experience of the unfavourable consequences of incision, I shall not again adopt such a proceeding. Setons have been passed through the swellings, but I cannot attest either their efficacy or safety."*

It may not be improper to add, that I visited a gentleman who was afflicted by a collection of fluid in the large bursa, between the glutæus maximus muscle and the great trochanter. From the nature of his profession, he was obliged to ride a great deal on horseback, which gave him great pain.

Notwithstanding he was advised to try fully the effects of friction and blistering, in order to dissipate the enlarged bursa, he determined upon opening it. He suffered extremely from doing so. Violent inflammation followed, which was succeeded by exfoliation of some thin layers of the trochanter major, and he did not recover until six months had elapsed.

Mr SAMUEL COOPER has observed,† "In some instances, the making too free an incision into the bursa mucosa has been followed by extensive phlegmonous erysipelas of the whole limb, ending in death."

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* *Vide* Elements of Surgery, p. 95.

† *Vide* Dictionary of Practical Surgery, p. 270. London, 1830.

POSTSCRIPT.

I shall conclude this volume by subjoining a notice respecting the distribution of the arteries upon the face of a stump, and a description of a preparation which has been made since the preceding sheets were printed, by Mr Spence, who threw ligatures around both the carotid and vertebral arteries of a grey-hound; and also a notice regarding the latest observations of Dr J. Reid (an account of which he read at the Meeting of the British Association lately held at Glasgow, 1840) upon the decussation of the fibres of the opposite corpora pyramidalia of the medulla oblongata.

In my Elements of Anatomy, I have described and represented the distribution of the arteries upon the face of a stump from a preparation of these, which had been made by my Father.

The main trunk of the artery and its ramifications upon the face of the stump have been said to be obliterated, being plugged up by coagulable lymph; but the figure which I formerly published is adverse to this supposition, because the arteries are seen filled by the common wax injection. A much more beautiful preparation has been lately made by Mr Spence, from the stump of a man whose leg had been amputated below the knee, in which the anterior and posterior tibial arteries were contracted, but the sural artery was considerably enlarged. The ramifications of the artery upon the stump have evidently been pervious, and are seen filled by the common wax injection ; hence it may be inferred, as has been proved by the experiments of my Father, Drs Verschuir, Thomson, Parry, Hastings, and Rossi, and others, that the flow of blood had been stopped by the contractile power of the coats of these arteries, which had been induced by the irritation of the stimulus applied, which contractility, as in the case of other muscles, had been followed by relaxation.

The following is a description of a preparation lately made by Mr Spence. He applied a ligature around each carotid artery of a greyhound on the 22d of April, and the right vertebral artery was tied on the 16th of May, and the left on the 30th of May 1840. The dog was killed on the 12th of the subsequent month of August, and the arteries were successfully filled.

Anastomoses re-establishing the Circulation in the Carotid Arteries.

1*st*, Between the branches of inferior and superior thyroid arteries.

2*d*, A free anastomosis between the superficial branch of the transversalis colli, with the muscular artery ramifying on the sterno-mastoid muscle.

3*d*, Large branches from the occipital arteries communicating with the vertebral around the transverse process of the atlas.

4*th*, By the vertebrals through the circle of Willis.

5*th*, A remarkable anastomosis is seen on the left side. A small vessel passes from the carotid immediately below the obliteration, ascends parallel to the obliterated portion of the carotid, and again joins that vessel immediately above the obliteration. During dissection this vessel was found closely connected with the cellular septum between the carotid and par vagum.

Anastomoses re-establishing the Circulation through the Vertebral arteries.

1*st,* A short branch communicating directly with the vertebral immediately above the obliteration, also two longer vessels between the same points forming arches.

2*dly,* A series of vascular communications from branches of the subclavian intercostals with the branches of the vertebral.

3*dly,* A deeper set of communications between the deep branches of subclavian, intercostals, and vertebrals, and also between the branches of the lower portion of the vertebrals with the branches of the portion of that artery immediately above, around the transverse process. These anastomoses (2*d* and 3*d*) form a series of superficial and deep arterial loops along each side of the neck.

In this case there were no newly-formed ramifications of arteries visible to the naked eye, whereas Dr Parry has stated, " that, in an experiment somewhat similar which he performed, there were five new ramifications uniting in different points, the extremity of the inferior portion of the old artery with the superior."

On the Anatomy of the Medulla Oblongata.

The experiments of Sir C. Bell, which have been subsequently repeated with similar results by Magendie, Beclard, Muller, and Mayo, have proved, that pain results from irritation applied to the posterior part of the spinal cord, posterior roots of the spinal nerves, and also insensibly : but, on the other hand, muscular contraction follows the irritation of the anterior roots.

In some cases, the nerves of sense and motion are separate, but in others they have a common envelope. It may be also observed, that the cerebral nerves enumerated as the third, probably the fourth, the anterior branch of the fifth, the sixth, portio dura of the seventh and ninth, are motor nerves, by which the eyeball, lower jaw, and tongue, are rendered obedient to the will. That portion of the fifth pair of nerves which is connected with a ganglion, communicates sensation to the eyeball, mucous membrane of the nose and mouth, and common sensation to the face.

Sir C. Bell's discovery as to the functions of the spinal nerves has received confirmation from the phenomena of disease, and also from the recent observations of Muller and Panizza on reptiles.

Dr Reid within these few days was so polite as to shew me his numerous dissections of the medulla oblongata, of which a faithful description has been published in the London Medical Gazette for October 1840, at page 63, of which the following is an abridgment. In the preparations it is distinctly seen, that the decussation of the pyramidal bodies is formed by the greater part, and in some cases by the whole of the fibres constituting these two eminences decussating with each other, and then passing into the *posterior part of the middle column.*

None of these decussating fibres run into the anterior column of the opposite side, and there is no other decussation in the medulla oblongata.

On tracing the olivary column, we find it passing downwards; it approaches closely to the anterior medium fissure, immediately below the decussation of the pyramidal bodies, and gives attachment to many of the roots of the motor nerves.

On tracing the olivary column, it is found to extend over the olivary body, giving origin to the hypoglossal and abducens along its anterior margin, and to the portio dura along its posterior margin. Part of this olivary column (as represented by Arnold in his beautiful and very correct views of the brain lately published) passes upwards to the corpora quadrigemina, giving origin to the smaller root of the fifth pair, and to the trochlear nerve.

Dr Reid also pointed out how the spinal accessory, and part of the filaments of the par vagum, may be connected with the motor column.

[Of the Pyramidal Bodies.]

Dr Reid also has preparations of that packet of fibres of the pyramidal body, turning round the lower edge of the olivary body, and proceeding upwards and backwards to the posterior column of the spinal cord. This packet of fibres has been represented in the plates of Santorini (Tab. 2, Parmæ 1775), who calls it *processus arciformis*. The pyramidal bodies are described in the text, page 25, as consisting of straight, oblique, and circular fibres, ex quibus processus *arciformis* processus fit, qui quidem difficilis visu ad imum medullæ oblongatæ prolatus, cirum corpora olivaria provehitur.

This arciform process has been depicted by Gall and Spurzheim, described by Mr Solly and Cruveilhier, and very faithfully represented in figs. 4th, 5th, and 6th, in table 1st of Arnold's plates of the brain recently published.

The decussation of the fibres of the opposite pyramidal bodies has been supposed to afford an explanation why palsy on the opposite side of the body results from injuries of the brain.* According to Hippocrates, wounds of the brain are succeeded by convulsions of the same side.

Lorry has stated, that when wounds were inflicted on the medulla oblongata, convulsions of the same side invariably followed, and palsy of the opposite side. There are exceptions to the above remark in two cases preserved in the museum of the University. Pressure made on the medulla oblongata in one proved the cause of complete palsy of the whole body, and constant pain in the neck; and, in the other, it produced insensibility, and a cessation of respiration after the lapse of two days.

Burdach has devoted great attention to this important point, and has stated that in 268 cases of injury of one side of the brain, in 10 palsy of both sides of the brain followed, and there were 258 examples of hemiplegia, and only 15 cases of palsy of the same side as the lesion. There were 25 cases of convulsion on the same side as the disease, and 3 only on the opposite side.*

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* *Vide* some very good observations on this subject by Dr Yelloly, in a paper on a case of Tumour of the Brain. Medico Chir. Trans. vol. i. p. 181.

In short, as far as I have observed, palsy generally occurs on the opposite side of the body, and if this palsy be accompanied by convulsions, the cause is seated in the medulla oblongata or parts at the base of the brain, or spinal cord, or in particular nerves.

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* *Vide* MULLER's Physiology, translated by BALY, vol. i. page 842.

FINIS.

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PLATE 1.

Fig. 1.

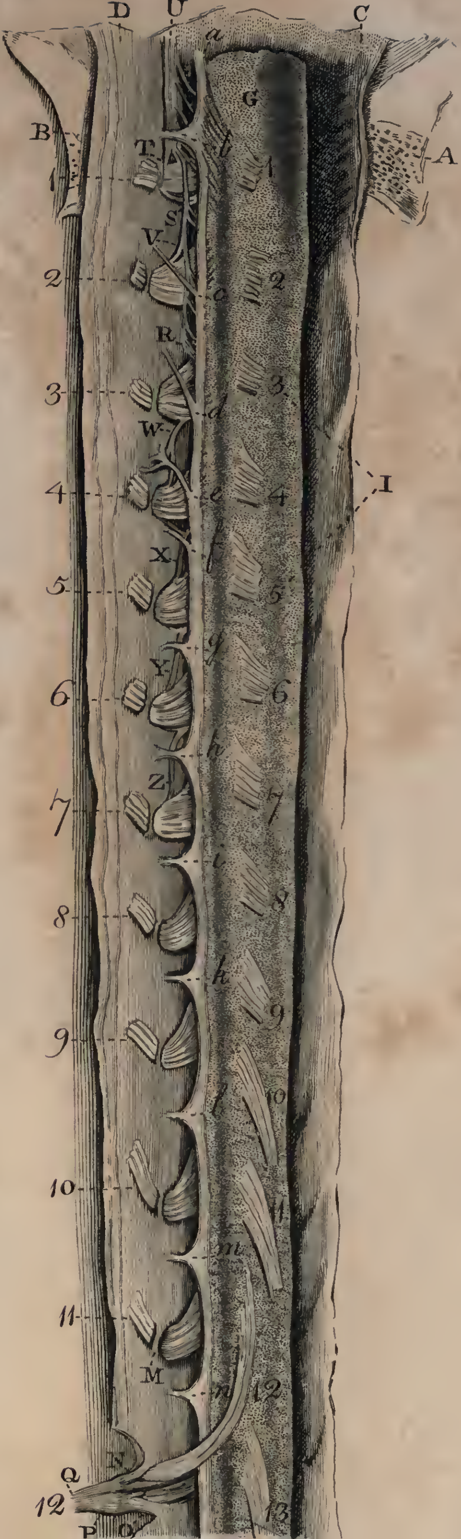
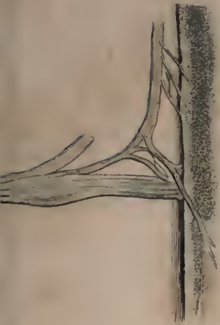


Fig. 2.



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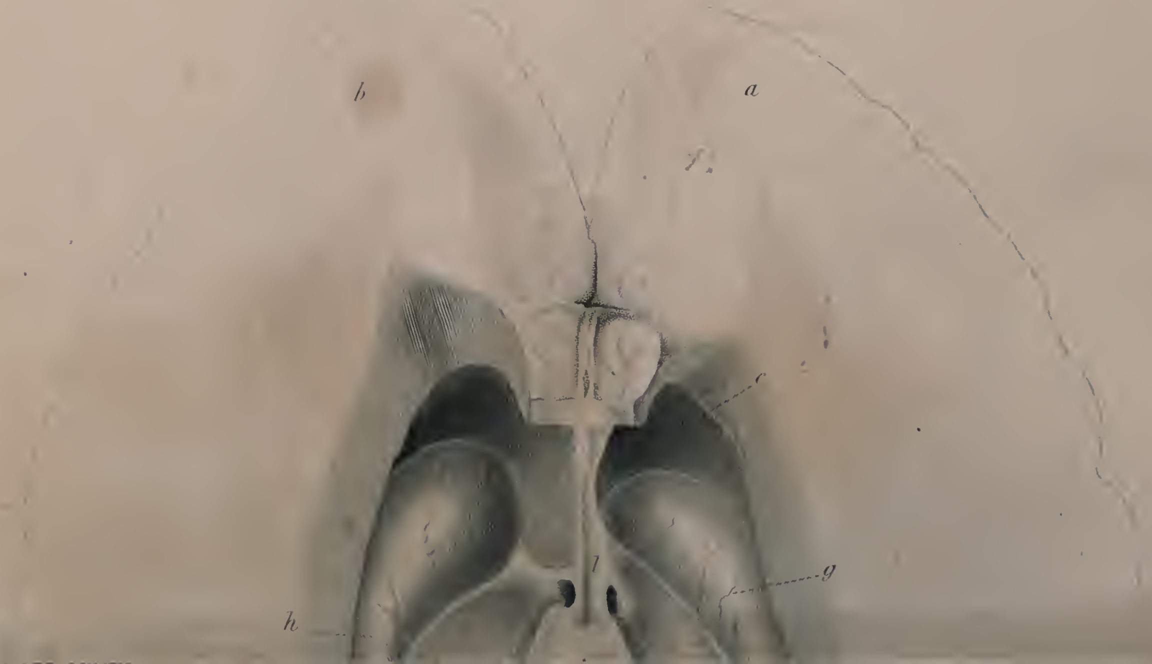
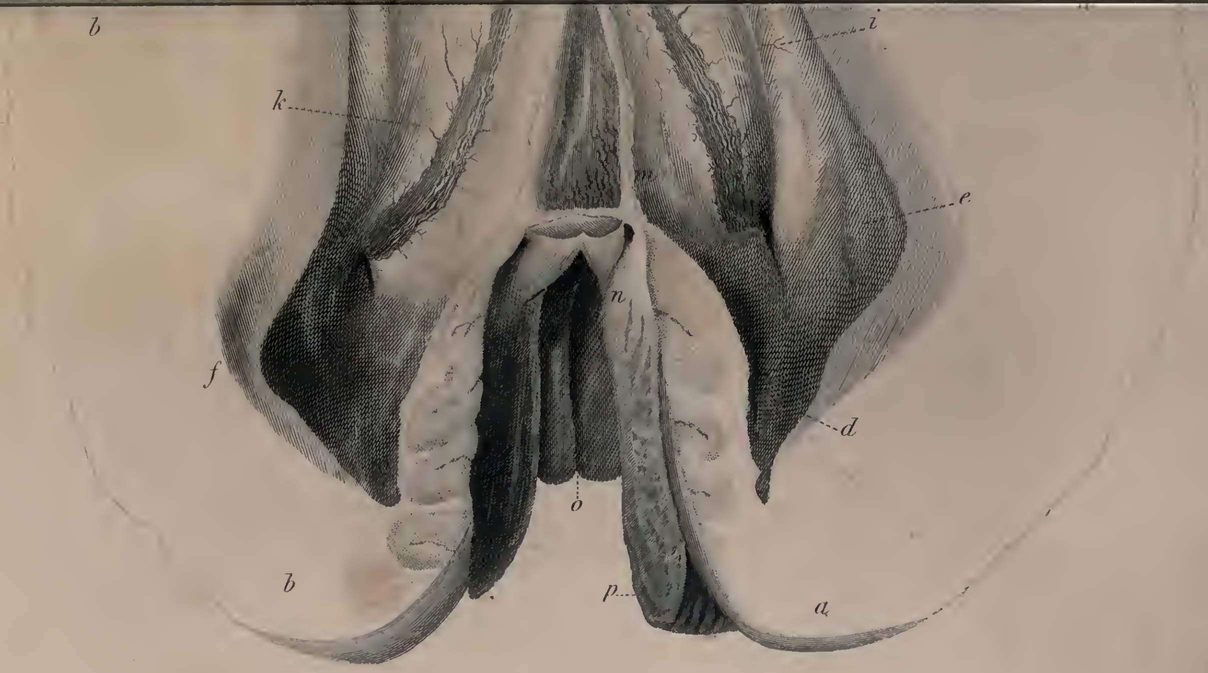




C.C. Greville M.D. ad. nat. del.^{t}

W. Miller Sc.

PLATE 3.

Fig. 3 the same object as Fig. 2 but more magnified.

Fig. 1.

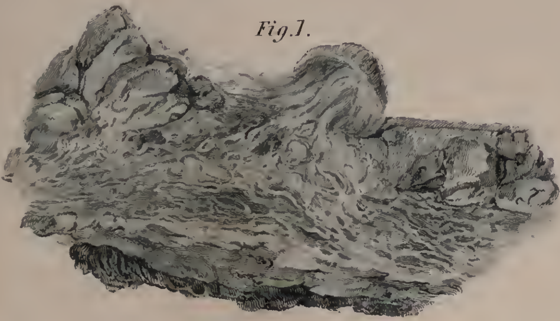
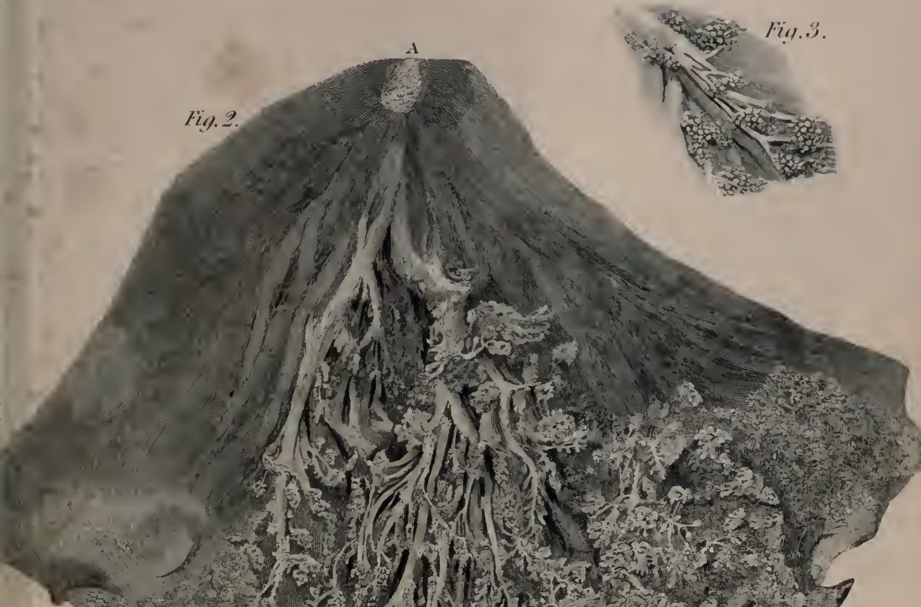


Fig. 3.

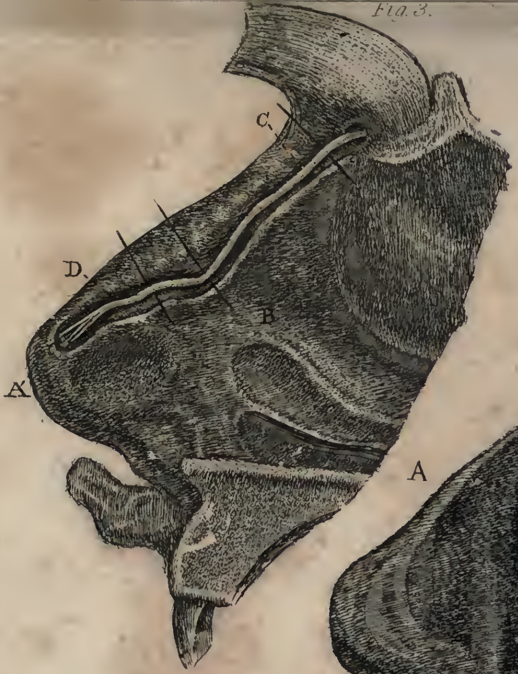
Fig. 2.



Thos Donaldson delt

PLATE I.

Fig. 3.



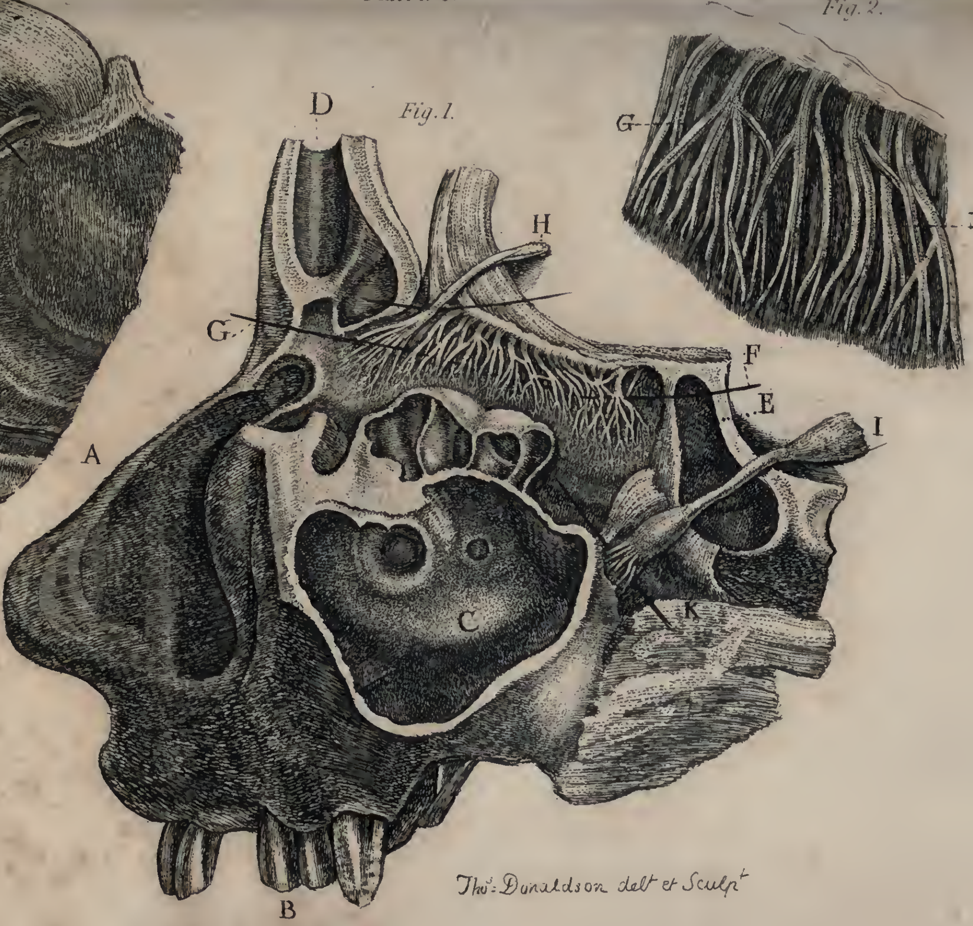


Fig. 1.

Fig. 2.

Thoˢ: Donaldson delᵗ et Sculpᵗ

PLATE 5.

Fig 1

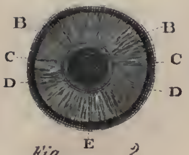
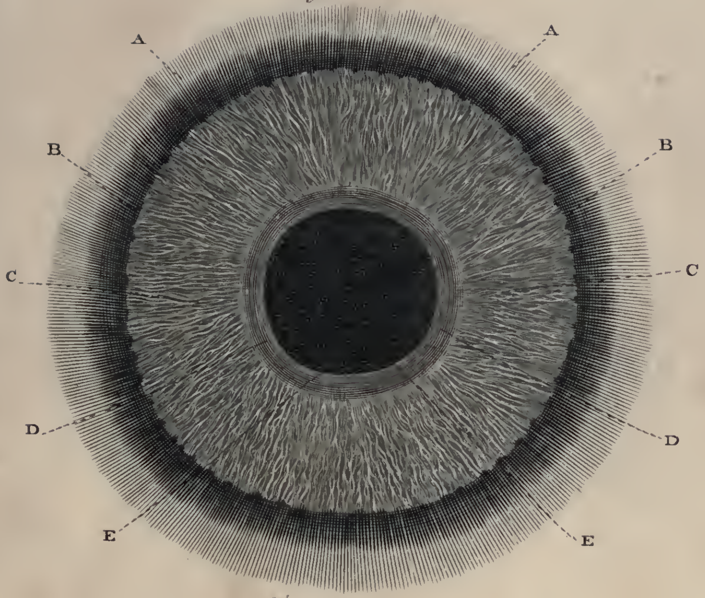


Fig. 2.



A. Fyfe del.

W. Archibald sc.

PLATE 6TH

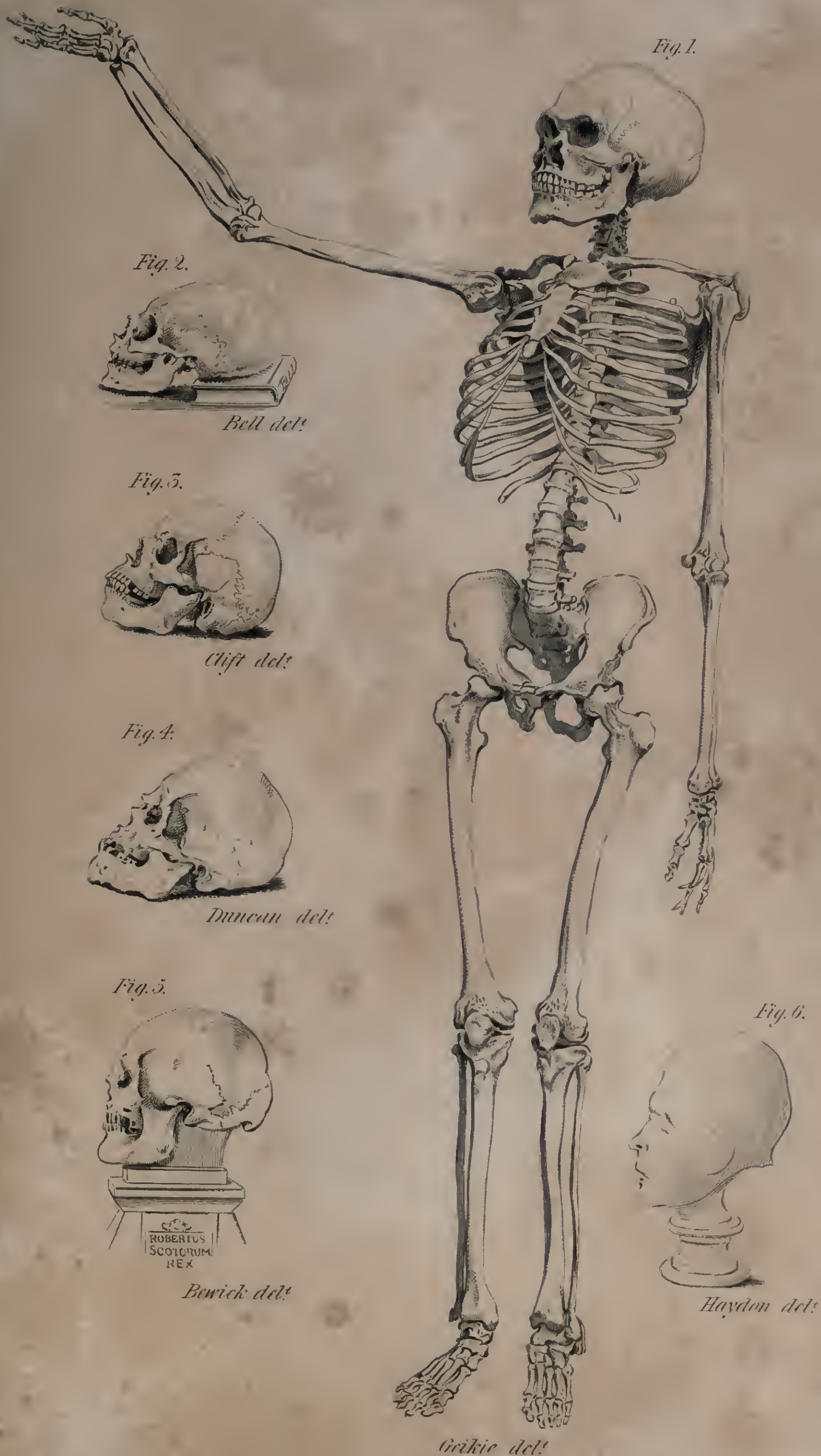
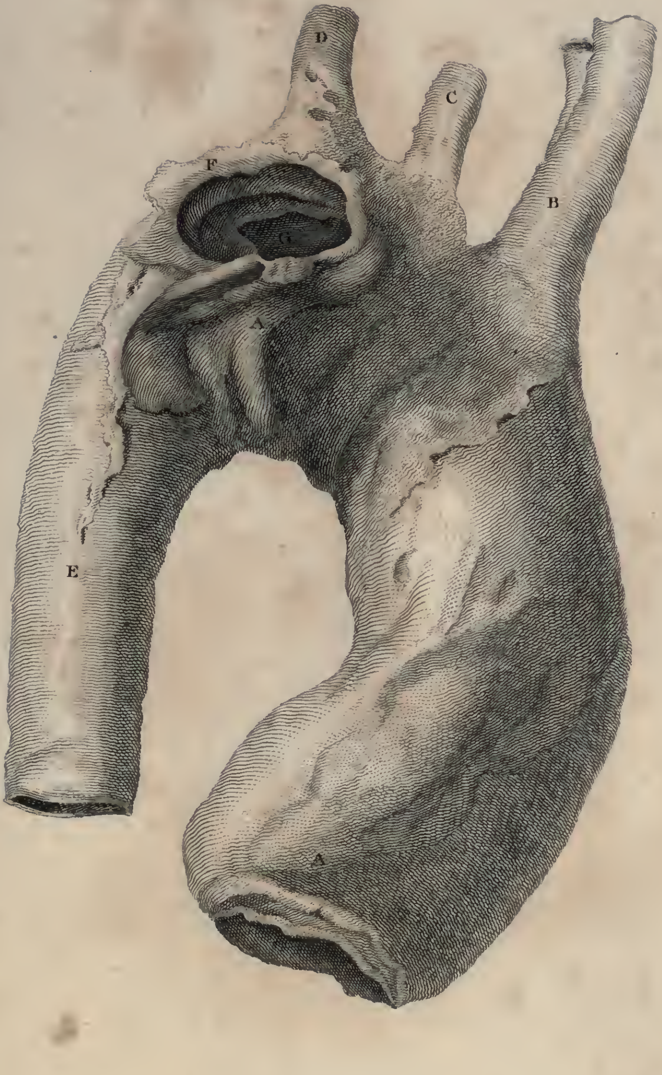


Fig. 1.
Fig. 2.
Bell delt
Fig. 3.
Clift delt
Fig. 4.
Duncan delt
Fig. 5.
ROBERTUS
SCOTORUM
REX
Bewick delt
Fig. 6.
Haydon delt
Geikie delt

PLATE 7.



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